ENGINEERING NEWS

MAYOR ROBBINS, of Providence, R. I., has appointed JOSEPH M. WILSON, of Philadelphia, A. P. BOLLER, of New York, and D. J. WHITTEMORE, of Milwaukee; all Members of the Am. Soc. C. E., and prominent in their profession, to prepare plans for improving the railroad terminal facilities of that city. This is an excellent selection and is going about the solution of an important public question in a most business like manner. All of these engineers have accepted and will go to work on the problem presented within one month.

THE New Hampshire Legislature has passed a bill which provides that no passenger, mail or baggage car on any railroad in that State shall be heated by any method of heating or by any furnace or heater, unless such method or the use of such furnace or heater shall first have been approved in writing by the Board of Railroad Commissioners; provided, however, that in no event shall a common stove be allowed in any such car, and provided also, that any railroad corporation may, with permission of said board, make such experiments in heating their passenger cars as said board may deem proper; provided also, that the provisions of the act shall not apply to mixed trains or trains which consist of freight and passenger cars. Any railroad corporation violating any of the provisions of the act shall forfeit a sum not exceeding $500.

A LAW just enacted in New York provides that from Nov. 1, 1887, floor systems shall be maintained on all bridges, so constructed as to support a derailed locomotive or cars, with guard rails or timbers so constructed as to guide the wheels in case of derailment. Guard rails shall be maintained upon the approaches to all bridges.

A CABLE-ROAD on Third Avenue in this city is being broached again. On Oct. 31 the stockholders formally decided to build such a road from Harlem bridge to the City Hall. $5,000,000 of 5 per cent. bonds are to be issued for this purpose, and the road is to be like the one already owned by the company on 125th street and Tenth avenue.

AN epidemic of waterway improvement seems to have struck the West, and among other schemes brought to the surface is the connection of Lakes Ontario and Huron by way of the Trent river valley. This canal would shorten the distance 220 miles over existing routes. But though the project is 50 years old, it hardly promises success, as a summit of 589 ft. above the waters of Ontario must be crossed and the line is extremly crooked: a bee-line would be 112 miles across and the proposed canal would be 335 miles long, from the mouth of the Trent, on Lake Ontario side, to the mouth of the Severn on the Huron side. From Kingston to the straits of Mackinaw, however, the route would be 567 miles as compared with 785 by existing lines of travel.

THE Board of Electrical Control of New York City have adopted a standard design for lamp posts that shall be hereafter erected by the Electric Light companies. The design contemplates a pole 20 ft. high, exclusive of the lamp frame. For a distance of 7 ft. from the surface of the ground, the pole is to be of iron, and above this it will be of hard wood. This combination of materials is intended to prevent, as far as possible, all danger to human life from shocks, as the wires carrying the current will not be visible at any point on the iron pedestal. The post is of ornamental design, and as no part of the pattern is controlled by any patent, any company will be at liberty to erect the poles at first cost of material and labor.

COUNT DE LESSEPS has announced to the French Academy of Science that the Panama canal will be opened on Feb. 3, 1890. It will not be entirely completed but 20 ships a day can be passed through it. He estimated that this traffic would produce an annual revenue of about $20,000,000. At 300 days to the year this estimate amounts to the pretty stiff toll of $3,333 for each of the 20 ships, and some of them may prefer to go around. We are told that by faith we may move mountains, and though Count DE LESSEPS certainly appears to possess a super abundance of this article, we fear it will not prevail against the Culebra, unless well backed by money and time. The precision with which the opening day is now fixed can only mean one thing, and that is a preliminary to a call for more vulgar cash.

THE case recently decided by the Interstate Commerce Commission, in which the Louisville, New Albany & Chicago Railroad is concerned is one of some importance. The company had arrangements by which they delivered wheat either to the Nickel Plate at Wanatah, Ind., on the base of a 25 cent charge to New York or to the Michigan Central at Michigan City, 20 miles farther north, on the basis of a 23 cent rate to New York. In this it was claimed the company was violating the long and short haul clause of the law. The commission held that the company did not control the through rates and had to conform to them or lose the business. They also found that the company's compensation on the pro rata mileage basis was greater from Indianapolis to Michigan City than from Frankfort to Wanatah, that is greater for the longer than for the shorter distance, and that there was no violation of the law.

THE absurd clause which the telegraph companies still continue to print on their blanks to the effect that they will not be responsible for any damages caused by the incorrect transmission of a message unless the sender pays for having it repeated, has been declared non-effectual by the Courts. In a recently decided case, a message quoted a price for certain goods at "two ten." The word "ten" was omitted in transmission. The sender brought suit to recover the difference in price and was successful. It may have been well enough when the art of telegraphy was in an experimental stage for a company to limit its liability in this manner; but in the present condition of electrical science it is rightly judged that a corporation cannot escape the consequences of carelessness or neglect by a mere disclaimer of responsibility.

THE receipts of the Brooklyn Bridge for October were $80,185, the largest of any month in its history. And the traffic is still growing.

IT is pleasing to see that the Herreshoff Company entered into the competition for new torpedo boats for the Navy Department, and what is more that their bid is the lowest. There is little doubt about obtaining the 22-knot speed demanded by the conditions of the call, if we can judge from the performance of the fast boats already built by this firm.

THE Memphis Western Waterways Convention is represented by delegates from 17 States, numbering 283 members in all. The purpose of the convention is to devise ways and means for the general improvement of the Mississippi river and its tributaries, aggregating 20,000 miles of river. The ultimate purpose is to influence national legislation, on the ground that the whole country has an interest in the proposed improvement, and that large appropriations are needed to bring about any definite and permanent betterments.

ACCORDING to *Herapath's*, the Messrs. CLARK, a well known English contracting firm, have submitted a very ambitious scheme for constructing a railroad from the banks of the Rio Paraguay, at a point near Asuncion, to Bolivia and Peru. The total length would be 1,885 miles and the estimated cost is $90,000,000. To begin with they want a 5 per cent guarantee on $45,000 per mile for the 620-mile Argentine section for 30 years.

THE following bridge accidents are reported: On Oct. 26, the railroad trestle over the canal at Augusta, Ga., gave way under a freight train, and 2 cars fell into the Canal.—On Oct. 29, about 50 ft. of the trestle on the Chicago, Milwaukee & St. Paul R. R., near Homer, Minn., was burned by incendiaries. An approaching passenger train was signaled.

THE most serious railroad accident of the week was a head collision at Silver Creek, N. Y., 40 miles west of Buffalo, on the New York, Chicago & St. Louis Railroad. Two freight trains, running at a high rate of speed met near the spot where the excursion and freight collision occurred a year ago, and were badly wrecked. Two men were killed.—On Oct. 28 a freight train on the Chicago, Rock Island & Pacific R. R. was wrecked between Menoka and Morris, Ill., by a telegraph pole which had been placed on the track, evidently for the purpose of wrecking a passenger train which, being behind time, was preceded by the freight. Two men were killed and another fatally injured.

THE preliminary work on the improved sewerage of Providence R. I. has progressed to the extent of nearly completed borings and soundings on the location of the main line of sewers, pump works, etc., and work upon the detail plans is progressing rapidly. Construction will probably be commenced early in the Spring of 1888. The borings at Field's Point show sand for 80 ft. down, says the Providence *Journal*.

THE last annual report of the City Surveyor of Montreal, Canada, in noting the necessity for better protection against floods, as shown in our issue of Oct. 1, says that in Jan. 1886, the St. Lawrence rose in the vicinity of the Victoria Bridge 21.7 ft. above city datum, or mean summer level of the river. This water filled all the cellars in the low districts. In April of the same year the water again rose 27.5 ft.

THE Spanish cruiser *Reina Regente*, lately built on the Clyde by the Messrs. THOMSON, has just made her official trips and attained a speed of 20.6 knots. This vessel has a displacement of 4,800 tons; has a protective deck 4¾ ins. thick; carries four 21-ton, six 12-c. m., and twelve small guns, and is fitted with five torpedo tubes. Her engines indicate 12,000 H. P. This test shows her the fastest cruiser in the world says *The Engineer*.

THE plans of Mr. SHEPLEY, a Boston architect, have been accepted for the new railway station at Hartford, Conn., and work upon the foundation will be commenced at once. The building will be nearly 500 ft. long, with a central waiting-room 175 ft. × 80 ft. and 28 ft. high. The estimated cost is about $200,000.

CHICAGO is following the example set long ago by New York, Philadelphia and Boston, and is about to double its area and add 140,000 people by the annexation of a number of the immediately adjacent towns, taking only the more densely settled portions to start with. The movement comes from the suburbs themselves, which feel the burden of heavier taxes, numerous local boards of all kinds to support, and yet lack very much in the way of proper fire protection, sewerage, street-paving, etc.

IN the settlement for damages by the Chatsworth disaster, the attorneys concerned seem to have fixed upon the following scale of payment:—Husband killed, $2000; wife killed, $1400; son injured, $2000; loss of eye, $500, etc. Human life is apparently cheap in that section, and judging from the scale it is more economical to the railroad company to kill a passenger outright than it is to maim him.

SPEAKING of the four tracking and other improvements on the Consolidated Road, the New Haven *Union* says that it is the intention of the company to fence in the central express tracks for a distance of about 500 ft. at each minor station, where no express stops are to be made. This is to prevent accidents from people getting on to the express tracks from way trains.

THE standard Prussian test for determining if the volume of a cement remains constant on hardening is: Pure cement is mixed with water to the consistency of a thick cream, and formed into a thin cake on either a glass or metal plate, or a roofing tile saturated with water. After setting, the cake and plate are placed under water and there allowed to harden, when any change in the volume of the cement is indicated in the course of a day or so by the crumpling of the cake or cracking occurring at its edges. A more severe test consists in allowing a cake of the cement formed as above, on a glass plate, to harden for a period of 25 hours in air, and then placing it in boiling water, when any tendency of the cake to crack at the edges or crumple is shown in from 10 to 60 minutes.

THE tank connected with the water-works of Franklin, Mass., burst on the morning of Oct. 27. This tank was of iron, 30 ft. high and 35 ft. in diameter and had been in use some time. But recently the tank had been raised 40 ft. by building brick piers under it and the job had only been completed a few days. The ruin is complete, and GEORGE H. NORMAN, the owner of the works, estimates the loss at $8,000. Among the most plausible theories advanced as to the cause of the bursting is the one that the brick piers failed under the weight, especially as the mortar either had not time to set, or was originally bad, as the report says that the bricks were washed clean from each other. The iron in the tank was also badly torn.

JOHN M. REID, of Allegheny City, Pa., has devised a new system of dams for improving river navigation. His device consists in confining the channel of the river within certain limits. In a stream 2,000 ft. wide, for example, he would build dams or piers exactly opposite to each other and leaving an opening of 500 ft. between them. These piers would be located at intervals of about 10 miles apart, depending upon the gradient of the stream. Sluiceways near the shore would reduce the current in the opening if this were too swift. His theory is that this arrangement would never stop the water, but only confine it to a certain channel; that it has no machinery to get out of order; that as the water flows past the first dam "it has a gentle current, and the farther it goes the less current it will have." His scheme is cheap, but lacks any actual experience to back it, especially as to its silting and channel cutting possibilities. There is some doubt, too, concerning the "gentle current" in the openings under all circumstances.

A NEW method of making foundations in wet ground is noted by *Engineering*. It is devised by M. BONNETOND, and his plan is to bore a hole 10 ft or 12 ft. deep and 1½ ft. in diameter in the damp ground, and in this a series of dynamite cartridges are placed and finally exploded. The expansion of the gases drives the water far out beyond the sides of the hole, and it does not return for at least one half hour. In this time the cavity is rapidly excavated and filled with cement concrete, which sets before the return of the water. The plan has been successfully tested at Lyons, and has led to very rapid work.

THE *Indian Engineer* says that the earth work on the Russian railway to Samarkand is completed as far as the capital of Bokhara and that the iron is at hand for the erection of the bridge over the Oxus Orders have been received from St. Petersburg to finish the line to Samarkand as soon as possible, and two infantry battalions have been sent to reinforce those already at work.

Report of the Commissioners of Sewerage and Water Supply for St. Johns and Portland, N. B.—The Commissioners have issued their report for 1886. The works beyond the city limits are Lake Latimer and Little River reservoir, with triplicate mains from the latter to the city boundary. The water is reported to be of good quality. The extensions of the water system made during the year were as follows: St. John 782 ft. of 4-in. distribution pipe, and 721 ft. of ¾, ¾ and ¾-in. lead service pipe; Portland, 3,293 ft. of 2, 4, 6, 8 and 10-in. distribution pipe and 1,920 ft. of service pipe; the total extensions amounted to 6,686 ft. The total pipeage of the water supply system at the end of the year was about 70.64 miles, with 4,903 stop cocks. In St. John there were 177 fire plugs, and in Portland 108. There were 134 meters.

The additions to the sewerage system of St. John would have been more extensive if the city's finances had been in a more flourishing condition; they aggregated 1,847 ft. of 9, 12 and 15-in. stoneware pipe. The total length of sewers laid by the Commissioners is 80,494 ft., inclusive of catch basins.

The report contains interesting tables and data relating to temperature, rainfall, etc., and is accompanied by the accounts for the year. A. CHIPMAN SMITH is Chairman of the Commission, and GILBERT MURDOCH, C. E., is Superintendent of the Sewerage and Water-Works.

Mattress Breakwater at Coney Island.—The mattress work being constructed at Coney Island, N. Y., for the protection of the beach, by A. M. Kanters, of Holland, Mich., sustained no damage from the recent heavy storm on the coast.

The City of London and Southwark Subway.*

J. H. GREATHEAD, M. INST. C. E., ENGINEER.

On the south side of the Thames are some of the most densely populated districts of the metropolis, and beyond these are others of the most rapidly growing. The only direct communication with the city existing, is that afforded by omnibuses traversing crowded thoroughfares, including London bridge. The tramways from the southern, south-eastern, and south-western districts terminate about

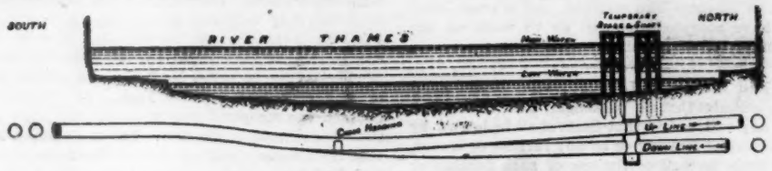


Fig. 1.—Section of River Thames and Tunnel.

three-quarters of a mile short of the city, because they have not been and could not be permitted to enter upon the overcrowded roads northwards of Great Dover street—see map, Fig. 1a. For the purpose of giving better access to and from the city, the Subway Company was incorporated by Act of Parliament in 1884, and empowered to construct a double line of subway from King William street to the "Elephant and Castle," Newington, and by an Act of the present session, the company has been invested with power to extend the line to the Clapham road at Stockwell, as also shown on the map. The subway will then be rather more than three miles in length. The "up" and the "down" lines will be carried in separate tunnels placed at such a depth under the surface of the roads as to avoid all interference with sewers and other underground structures. An inspection of the map will show that, except where the line is under the river and an adjoining wharf, it will pass throughout its whole length under the streets, thus enabling it to accommodate the great stream of passenger traffic between the city and the borough, Newington, Kennington, Stockwell, etc., now passing over London bridge, without appreciable deviation from the present course of the traffic.

There will be stations at the Monument, King William street; Great Dover street; the "Elephant and Castle;" New street, Kennington; the Oval; and Stockwell; and, if satisfactory arrangements can be made with the railway company, near the Brighton Railway Company's terminus on the south side of the Thames. At each station, powerful hydraulic lifts are to be provided in addition to stairways, for the purpose of giving easy and speedy access between the street and the platform levels, and in order to avoid double establishments on opposite sides of the road, at each station the "up" and "down" tunnels will there be placed at different levels, so that passengers may pass readily from the lifts or stairs on one side of the road to either platform. The steepest gradient against the load will be about 1 in 30, but the line throughout the greater part of its length will be practically level.

Steam locomotives are not to be used upon the line. The Act specifies that the "traffic shall be worked by means of carriages propelled upon the system of the Patent Cable Tramways Corporation, Limited, or by such means, other than steam locomotives, as the Board of Trade may from time to time approve." The endless cable system of traction has for some years been in successful use in a number of cities in America and elsewhere in connection with street tramways, and it is now being laid down in Edinburgh and in Birmingham—where it will shortly be at work—having been first introduced in this country on a small scale at Highgate. In this connection, the system is hampered by the presence of the general street traffic, and by the necessity of burying the cables in small tubes beneath the surface carrying the traffic, the attachment of the carriages to the buried cable having to be made through a continuous narrow slot in the street. In the subway the cable system will have a fairer field.

The cable system of working tramways has been so frequently described that it will suffice now to state that the endless cable passing from the hauling engine to the termini of the line upon one line of pulleys, and returning to the engine upon another line of pulleys, is kept in continuous motion throughout the period of working from the start in the morning to the stop at night. Along the course of the line, the carriages are, by attaching themselves to or detaching themselves from this moving cable, continually starting, running, and stopping as their own or the general street traffic requires. By using one line of cable, they run "up," by using the other they run "down." Steep gradients have no terrors for them, and they pass up a hillside of 1 in 4½ at the same speed as they run upon the level. All moving independently, they are yet actuated from one station. This power of independent motion is secured by the use of what is termed a "gripper"—simply a pair of jaws actuated from the carriage by levers or screws so placed and adjusted as to close upon the moving cable when it is desired to start and to release the cable when it is desired to stop. One great advantage of this mode of working in the subway is that light trains can be economically run at short intervals, in place of the usual heavy locomotive trains at longer intervals, and thus delay, and accumulation of passengers at the stations will be avoided. As the average speed will be about the same as on the Underground Railway—ten miles per hour—it follows that, the initial delay being less, the service will be more rapid, especially for a short-distance traffic. It is intended, in the first instance, to run every two minutes trains capable of seating 100 passengers. Steam locomotives being excluded, the question of ventilation becomes a very simple one, and the traffic in each tunnel being always in one direction, a continuous current of air will be established in the same direction, which current can readily be dealt with by a small expenditure of mechanical power if necessary. It is expected, however, that the variations of pressure, due to the movement of the trains on approaching and leaving the stations, will accomplish all that will be required.

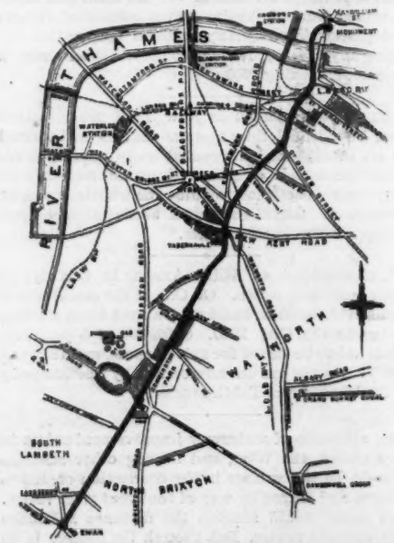


Fig. 1a.—London and Southwark Subway.

The whole of the power for the traction and the lifts will be concentrated at one point, about the middle of the line, viz., at the "Elephant and Castle." There will be two endless cables, one passing to and from the city, the other to and from Stockwell. Hydraulic pressure and return water pipes will be placed throughout the length of the subway for the working of all the lifts, and any other small power machines in the subway.

The carriages are to be of the longitudinal type, with platforms and entrances at the end, similar to

*Paper read before Section G British Association, as given in the "Engineer."

Pullman and ordinary tramway cars. They will be very commodious, giving greater height and width than the second and third-class carriages in use on the Metropolitan Railway—see Fig. 5—and to each passenger about 30 cu. ft. of capacity as compared with the 20 required by the Board of Trade regulation for railways. The stations are to be lighted by electricity, with gas in reserve. In connection with the permanent way no ballast will be used, and the absence of heavy locomotives will enable a smooth line to be maintained at comparatively small expense.

Having given this short description of the nature of the subway communication, the author will now proceed to give some details of the mode of construction of the works, and the appliances devised for driving through water-bearing strata, should such be met with. The two tunnels for the "up" and "down" lines are absolutely separate and distinct between the termini, and are therefore capable of being carried in any desired position relatively to each other. Commencing side by side in the city, the "down" line falls more rapidly than the "up," in order that when the Swan lane is reached the former may be immediately under the latter, because, except, in this position, they could not be constructed without encroaching upon private property or rights. In this position they pass under the northern foreshore of the river Thames, but before the southern shore is reached they are again side by side as required by a clause in the Act—and at each intermediate station, as already described they are at different levels. The diagram (Fig. 1.) shows the tunnels as they have been constructed under the river. Each of the tunnels is 10 ft. in diameter, and is formed of rings of cast-iron segments bolted together through internal flanges, as shown in Fig. 2. The rings are 1ft. 7 in. long. All the flanges are 3¼-in. deep, and 1¼-in. thick. In the longitudinal joints thin strips of pine are inserted between the flat surfaces of the iron, and subsequently pointed with cement. The circular joint are made by tarred rope and cement.

The Act for the first section of the subway was, as already stated, passed in 1884, but it was not until May, 1886, that the company, under the chairmanship of Mr. C. G. MOTT, was in a position to go on with the work. The first operation was to erect staging in the river at Old Swan Pier for the purpose of sinking a temporary shaft and constructing the river tunnels. An iron-lined shaft, 18 ft. in diameter, was then sunk into the bed of the river through sand and gravel into the London clay. From this shaft was driven the first tunnel, commenced in November last year, and now extending under the river, Hibernia wharf and the Borough road, for a length of 1600 ft. The second or lower tunnel was commenced at a later date, and is being driven simultaneously with and at the same rate as the first. Both the tunnels have also been driven northwards for some distance into the city, four faces being thus worked from one shaft. The second tunnel was driven immediately under and within 4-ft. 6-in. of the upper tunnel. Work is also progressing at Great Dover street. It will be observed that the first or upper tunnel has a dip under the river and that the second or lower tunnel rises continuously from the shaft. A cross-heading joining the two tunnels at the lowest point of the first provides for draining that tunnel to the sump at the temporary shaft, whence the small accumulation of water will be discharged automatically by an injector hydrant, deriving its supply of high pressure water from the hydraulic main already referred to.

The mode of constructing the iron tunnels is very simple, and can be described in a few words. A steel cylinder, overlapping—like the cap of a telescope—the forward end of the iron tunnel is provided near its front end with diaphragm, Fig. 6, having an opening or door in it. Beyond this face project adjustable steel cutters, and behind it are ranged, round the circumference inside, six hydraulic presses, so fixed as to abut against the last ring of the completed tunnel. As the material is excavated from before the cap or shield by the miners and action of the cutters, and thrown back through the opening in the face, the shield is forced forward by its hydraulic presses. The shield thus clears out an exact circle somewhat larger than the outside diameter of the iron lining of the tunnel. The small annular space thus left is filled with grout composed of blue lias lime by means of an apparatus to be presently described. When the shield has been forced forward sufficiently far, a fresh ring of iron lining is built up inside and under cover of the overlapping steel cylinder. Six of these rings can be erected daily, representing a rate of progress of 9 ft. 6 ins. at each face.

The apparatus for grouting is shown in section in the plan. The lime is mixed with water in the cylindrical vessel, Fig. 3, the lid is closed, and compressed air at a pressure of about 30 lb. per sq. in., from a compressor at the shaft, is admitted through the upper valve, when, the lower valve being opened, the contents of the vessel are discharged through a short length of hose-pipe, a branch and a nozzle, into the annular space left outside the iron lining by the advance of the shield, holes being provided in each segment of the lining for the purpose. The grout is first of all forced through the lower holes in the segments until it appears at the holes above; the lower holes are then plugged, and the grout is forced into the next holes above, and so on until the grout comes out at the topmost hole, in which the nozzle is then inserted, and the grout forced in by the full pressure of air until the space is completely filled.

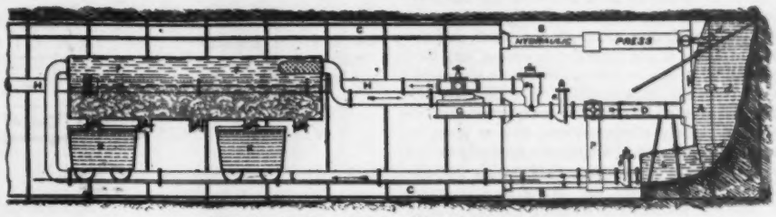
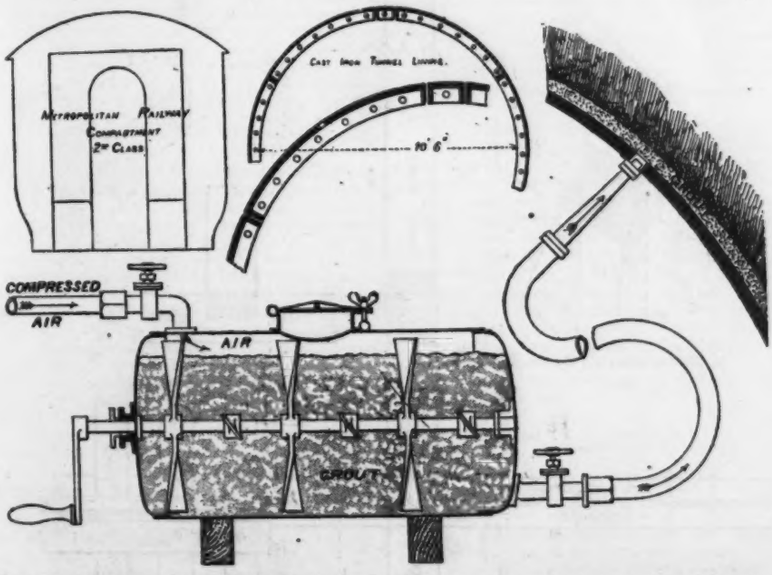


Fig. 4.—Proposed Tunnelling Apparatus.

Thus the iron lining is surrounded by a coating of lime or cement. The paddles upon the spindle, actuated by a handle, are kept continuously at work to mix the grout, and to prevent its setting in the "grouting pan." A somewhat similar mode of construction was employed in 1868-9 in executing the little tunnel under the Thames at the Tower, originated by the late Mr. PETER BARLOW, and carried into execution by the author. There, however, hydraulic and pneumatic power were not employed,



Figs. 2, 3 and 5.—Sections of Tunnel Cylinders, Grouting Apparatus, and Comparison of Carriages.

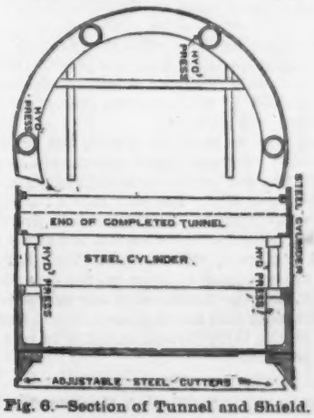


Fig. 6.—Section of Tunnel and Shield.

and the area of the tunnel was considerably less than half the area of each of the present tunnels. In the interval between that work and this, several not very successful attempts have been made in America to construct brick-lined tunnels with shields of similar construction to the one used at the Tower. When it is considered that an inch thickness of cast iron will offer a resistance to crushing as great as several feet in thickness of well set brickwork, and indeed in case of small tunnels, greater than any thickness of brickwork, and that at the same time it can be made perfectly water-tight, it is surprising that no use has been made of iron as a lining for subaqueous tunnels, and for tunnels where great strength is required, or when it was important to construct the work rapidly, without interference with street surfaces, or danger of settlement, and with a minimum of subsoil disturbance. In cases where tunneling has to be done through *soft* or loose material full of water, in place of the single opening in the shield as already described, the arrangement shown in longitudinal section (Fig. 4) can be employed. The shield remains much the same, but the material is removed from its path by other means, viz., by a current of water aided by disintegrating protruding tools actuated from the inside of the shield.

Referring to Fig. 4, the cylinder *B* of the shield slides over the completed part of the tunnel *C*. Through the front of the shield *A* a protruding tool of the form shown, or a revolving crosshead, or both, pass through stuffing boxes and assist in loosening the material in front, while water forced by the rotary pump *G* through the nozzle *D* scours out the *débris*, and carries it into the depositing tank *F*. The *débris* settles in the tank, and the water is used over again. The circuit of the water being

closed, the pump has no more work to do than overcome the friction of the pipes, and give the required velocity to the current. To empty the depositing tank, the valves *E E* are closed, and tubs *K K* filled with water are brought under the outlets *F F*, so that the projecting lip of each outlet becomes immersed in the water. Upon opening the valve the *débris* from the tank falls into the tubs, while water from the tubs ascend into the tank to take its place. The pocket or chamber *L* is provided for the purpose of dealing with boulders or larger pieces of *débris* than would pass through the pipes, and the face of the shield is put together in such a way that any portion of it can be taken down from the inside under air pressure when desired. In some cases the face may be divided into cells or compartments provided with tightly closing doors, one or more of which could be opened at a time for working on the material in front, or clearing it of larger impediments, such as boulders, air being in such cases forced into the material in front of the shield so as to displace the water therefrom.

Sir JOHN FOWLER is the consulting engineer, and the main contract for the construction of the subway between the city and Newington is being carried out by Mr. E. GABBUTT, of Liverpool.

The total cost of the line from beginning to end, including land, buildings, stations and equipment, will not, it is estimated, exceed £200,000 per mile—a small fraction of the cost of the underground railways in London.

Iron Joint-Plates in Trestlework.

The accompanying illustration shows a method of joint-making on trestlework as used at MCNAIRS, on the N. Y. L. E. & W. Railway in 1882, and for which we are indebted to Mr. ANDREW BRYSON, of this city, who designed the work.

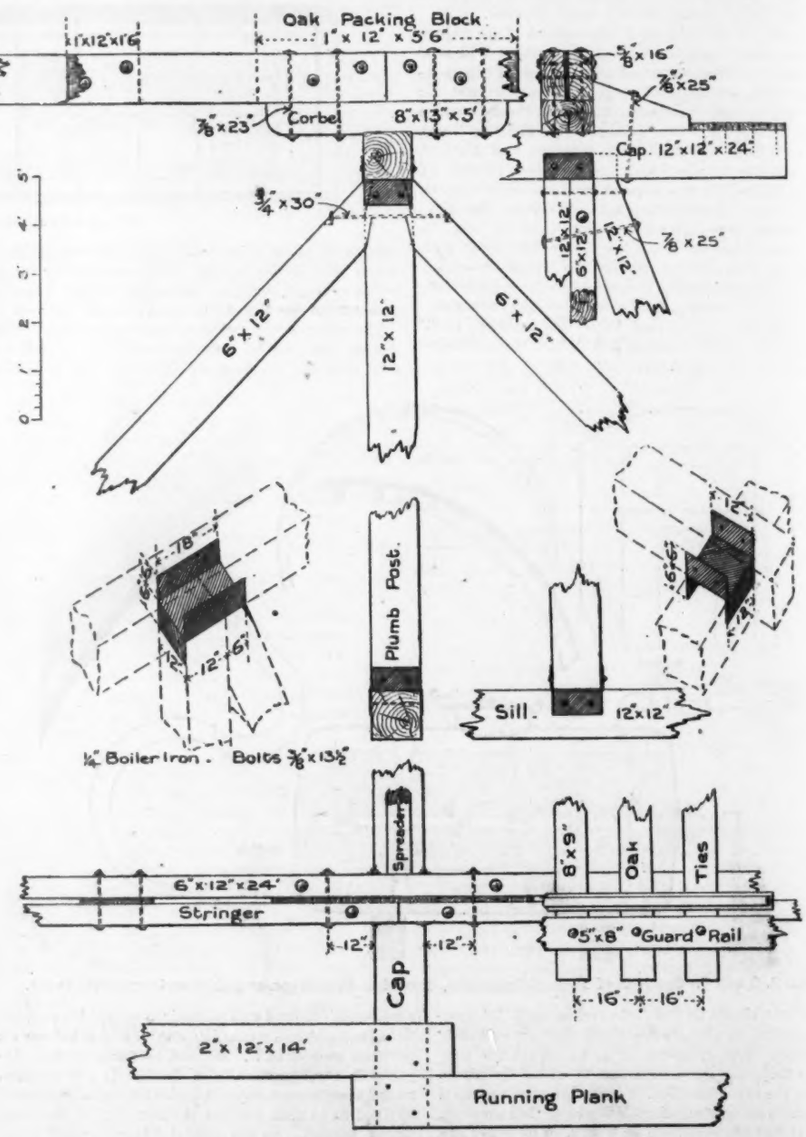
The purpose is to avoid all tenons, jogs or other cutting of the timber and at the same time to make a thoroughly firm and secure connection between the posts and caps or sills. The plan shows the application to various joints. No thickness is given for the plate, but we understand that it is not heavy and is secured in place by spiking only. The chief advantages are a saving of labor on the ground in tenons, etc., and the avoidance of any openings or cuts in the timber that might hold water and hasten decay. The plan is simple and is said to be very effective in practice.

The Sinking of Two Pits at Gneisenau Colliery, near Dortmund.*

The strata above the coal at this place include 52 ft. of drift sand and clay and about 700 ft. of marls, which are close at the top, but fissured and water-bearing below. There are also two beds of green marl 3.28 and 5 ft. thick respectively, and about 36 ft. of green sand at the bottom, which is generally plastic and stops the downward percolation of water from the upper measures; but in the locality in question this plasticity is not well developed. In 1873 the company, then proprietors of the mine, commenced a shaft at this spot. After a somewhat difficult sinking through the upper alluvial beds, the ground was secured by cast-iron tubbing wedged with wood, and the upper marls were traversed without special difficulty to a depth of 570 ft. when fissured ground was reached, yielding from 5,500 to 6,600 galls. of water per minute. The sinking was then abandoned and the bottom was plugged with a layer of concrete 45 to 50 ft. thick, with the intention of resuming the work at a later period. Nothing was, however, done until 1882, when a new company was formed, who decided to complete the shaft by boring down to the Coal Measures, and to put down a second one in the immediate vicinity by the same method.

On July 1, 1882, the operations were commenced by drawing the water with a bucket, and when this was done all timbers and other materials built into the shaft were removed to give free play to the boring-tools. On Dec. 20th the boring by Messrs. KIND and CHAUDRON'S method was commenced, of a diameter of 5 ft. and reached the Coal Measures at 788 ft. in June, 1883, and the first coal seam at 807 ft. On July 1, 1883, work was begun with the large borer of 14.26 ft. diameter, and considerable difficulty was experienced in boring through the original concrete stopping, which included large quantities of extraneous substances, such as oak timbers, steel tools, and iron ladders, which had to be cut to pieces by the borer before the marl below was reached. Other difficulties of a similar kind were experienced from imbedded flints and hard beds which occur irregularly in the lower marl strata. In February, 1885, the level proposed for the moss-box was reached at 792 ft. or 4.6 ft. within the sandstones of the Coal Measures. As the water-bearing bed is only encountered at a considerable depth below the surface, Mr. CHAUDRON considered that the shaft might be rendered perfectly safe by tubbing it through the fissured ground only, and stopping the water by a lining of concrete between the tubbing and the rock, instead of building a column of cast-iron rings up to the natural water-level in the shaft, as had been done in all previous cases. As this proposition seemed likely to effect a large saving in the cost of the sinking, the proprietors determined to try it; but as no data were available for forming an opinion as to the resistance of concrete to the pressure likely to be encountered at such a depth, it was resolved to apply the new method only in putting down the second pit, while the first was finished on the old system, in so far modified that provision was made for pulling out so much of the column of tubbing as could be spared, when a water-tight joint had been made above the fissured marly ground. The rings so covered would then be available for use in the second sinking.

The building of the tubbing was commenced on March 4, 1885, and although some delay was experienced, owing to defective flange joints which had to be replaced before they could be made water-tight, the moss-box was lowered into its place by April 13. The building then went on continuously, electric light being used at night, and as many as 12 rings (13 ft. 1½ ins. diameter inside the 5 ft. high) having been put together in 24 hours. The total weight of the tubbing which was by Messrs. HANIEL & LUEG, of Düsseldorf, was about 1,500 tons. The compression of the moss-box went on regularly, the depth of the layer of moss being reduced from 3 ft. to about 10 ins. The concreting, which was done with 4 ladles suspended by wire ropes that were used alternately, was begun on April 19, and finished up to the level of 512 ft. on the 27th.



Iron Joint-plates in Trestle work.

In order to ascertain the most advantageous composition for the concrete backing, which had to resist pressures varying from 14 to 24 atmospheres, numerous experiments were made with mixtures of cement and sand in varying proportions, which were cast in tubes, and, after being allowed to set, were subjected to considerable pressure. The best results as regards impermeability were obtained with pure cement, which, however, was too costly to be employed for the whole length of the column (279 ft.). The details of the mixtures adopted are given in the account of the second sinking.

The concrete was left to harden until May 17, when the lifting of the water out of the shaft was commenced. On June 4, the false bottom of the tubbing was removed, and the moss-box having been found to be watertight, the sinking was resumed in the Coal Measures. On June 18, a bearing crib was laid at 798 ft., upon which a series of closing rings were built up to finish the joint up to the moss-box, which was done on June

*This is an abstract of an account furnished by Mr. H. TOMSON, director of the Gneisenau Colliery, contained in a memoir on "Novelties and Progress in Sinking in Loose Ground," by Mr. H. LUEG, of Dortmund, published in the Zeitschrift für das Berg-Hütten-und Salinen-Wesen, vol. XXXV, Abhandlungen, p. 1, and taken from the "Selected Papers of the Institution of Civil Engineers."

25. It now remained to draw the water out of the circular space above the concrete, and to remove the upper part of the sinking columns of tubbing. The first operation was effected by means of very long and narrow kibbles. When the level was lowered a certain distance, a flow of about 26 galls. of water per minute, due to a broken segment of the old tubbing near the surface, was discovered; but after this was repaired, the drainage went on regularly until the concrete joint was dried. The upper tubbings were then taken out in a very few days, as the shaft was entirely free from all fixed obstacles. The space behind the uppermost permanent ring was then concreted with pure cement, and a closing curb, made up of two rings built together in 10 segments, was laid at the level of 516 ft. The bottom ring is united to the top ring of the tubbing by 90 bolts of 1⅛ in. diameter, the joint being packed with lead. A conical ring of masonry built upon the closing curb forms the footing of the wall lining the shaft through the impermeable part of the wall above. In order to stop water coming from above, a screen of 6 light iron tubbing-rings is carried to a height of 30 ft. within the walled part of the shaft, and as the space behind is not filled with concrete, lodgment is afforded for about 6,000 galls. of water.

The subsequent sinking in the Coal Measures was carried on without any particular difficulty in the ordinary way to a depth of 1,295 ft.

Pit No. 2, which is 115 ft. from No. 1, was begun on Jan. 9, 1883, a brick cylinder of 28 ft. internal diameter, 4 ft. thick below, 3 ft. 8 ins. at the top, and weighing about 1,200 tons, was used in the upper alluvial ground, the excavation being effected partly by buckets, and partly by a Körting mud-elevator. The wall continued to sink until the first bed of gravel flints was reached, when it remained fast; the sinking was then continued by hand, and on March 16, the marl bed was reached at 54 ft. when the inflow of water suddenly increased from 44 galls. to 570 galls. per minute. At 80 ft. a segmental tubbing of cast-iron wedged with iron, was commenced, and on May 11, it was completed. The water then diminished to 275 galls. and was kept down by a pulsometer.

For the deep sinking a pair of direct-acting winding-engines with cylinders 20 ins. in diameter, and of 48 ins. stroke, with a conical drum 3 ft. 4 ins. in diameter, and a powerful steam-capstan with 10-inch cylinders, 16-in. stroke, working a drum of 3 ft. 4 ins. diameter by a double train of spur-gearing, were used. The larger engine was devoted to raising and lowering *débris* and materials, while the steam-capstan carried the working platform for the masons by a steel wire-rope 2 ins. in diameter. The sinking-tubs were guided by wire-ropes 1 in. in diameter, made fast to a cross-bar below, bearing against sockets in the shaft-wall, while their upper ends were passed round the drum of a windlass. By simply slacking the strain on the rope, the cross-bar was released, and the whole could be brought to the surface.

A continuous ladder-way was provided down the center of the pit, as a means of escape for the sinkers, in the event of any great outburst of water. The ladders, made in 16½-ft. lengths, were connected by fish-joints, and suspended from a strong cross-timber at the surface. A flat iron bar ran parallel to the ladder on either side at a distance of 24 ins., and was connected with it by iron rings, which were cased with wooden lattice-work. Resting and changing platforms, 15¾ ins. wide, were placed at 16½ ft. intervals. The total weight of this arrangement was 33 lbs. per ft., and it was so arranged, that when the shaft became inaccessible, the whole could be pulled up and taken to pieces in lengths by unscrewing the fish-bolts. The pulsometers were hung by wire-ropes from hand-windlasses; the rising pipe, 12 ins. in diameter, was of galvanized sheet-iron, and the steam-pipe was a drawn tube of 3½ ins. in diameter. The latter was connected at the surface with a horizontal steam-pipe 40 ft. distant, which allowed the depth of the pulsometer to be altered 13 ft. without lengthening the steam-pipe.

The working platform for the masons was made of wrought-iron, with four projecting horns for fixing it in position during the building of the shaft wall. The whole of these arrangements were found to answer admirably, and are recommended in all cases where there is a possibility of having to substitute boring for hand work at the lower part of a deep sinking.

The sinking through the marl was resumed on June 18, with the following succession of events: The first set of wedged tubbings was finished on July 30, and a second at 160 ft. on Sept. 5, when the water diminished from 106 galls. to 9 galls. per minute. A third set at 200 ft. was completed on Oct. 22, when the influx was further diminished to 3 galls., so that the pulsometers were no longer required, and the drainage was thenceforth effected by buckets.

The first length of walling was commenced upon a cast-iron crib at 308 ft., and was finished Dec. 28, 1883; the second from 416 ft. on Feb. 26, 1884; and the third from 519 ft. on May 3. The flow of water was then 5 galls. per minute. At 523 ft. the diameter of the pit was diminished to 14 ft. 9 ins., and as the water-bearing bed was approached, the distance below the footings of the lengths of walling was diminished. To prevent the rise of water between the rock and the walls, a narrow space was left behind the latter, which was filled up with pure cement. The first notable influx of water occurred on Aug. 22, 1884, at 656 ft., at which date the shaft was completely walled down to 650 ft. The whole of the sinking plant and appliances were then pulled up, and on Aug. 31 the pit was cleared for boring under water. The advanced bore of 6 ft. 6 ins. diameter was begun on Oct. 15, reached the Coal Measures at 795 ft. on Feb. 25, 1885, and was continued to 836 ft., when it was contracted to 4 ft. 9 ins. in diameter down to 846 ft. The object of the contraction was to form a bearing for the sludge-collector, which was left at the bottom during the subsequent boring out to the full size.

The full-sized boring (15 ft.) was commenced in May, 1885, and completed to the seat of the moss-box at 720 ft. on Oct. 3.

The tubbing was built with a false bottom, the rings being bolted together with lead packing at the joints. When a number of rings equivalent to the depth of the fissured ground had been put together, a cover was added, similar in form to the false bottom with a valve which was kept shut by the water above it, but could be opened by a lever or a chain worked from the surface. Water was then admitted in such quantity that the weight of the closed tubbing somewhat exceeded that of the water to be displaced below, so that by careful manipulation either by rods or ropes, the whole mass could be lowered as easily as one of only a few hundred-weight. In order to expel the water below the false bottom a central rising pipe is attached to the latter passing through a packed joint in the top cover. For the final compression of the moss-box the tubbing is loaded with water by filling it through the valve in the cover. The tubbing is kept centered during the sinking by four cast-iron guides bearing on the wall of the shaft.

The building of the tubbing up to 240 ft. was finished on Nov. 3, when the cover was fitted, and the lowering commenced on Nov. 6. On the evening of the 8th, the moss-box reached the shaft-bottom, when the top valve was opened, and the compression of the moss packing went on regularly. No accident of any kind occurred during the operation, whose success fully justified Mr. CHAUDRON'S bold innovation upon the original practice.

The concreting was begun on Nov. 15, 1885, and finished on the 19th. Eight wire ropes of 0.39-in. diameter, attached to the second ring (from the bottom) of the tubbing, and paid out as the latter sank, formed guides for the four concreting ladles. The mixtures used, which were the same as in Pit No. 1, were as follows:

		ft.
Pure cement	up to	787
1 part " 1 part sand	"	755
2 parts " 1 "	"	670
Pure cement	"	649
1 part " 2 parts sand	"	610
2 parts " 1 "	"	603
Pure cement	"	599

The concrete was left to harden until December 28th when the drawing out of the water began. On January 3, 1886, the top cover of the tubbing was reached at 561 ft. and the concrete was found to be perfectly tight. The cover was then removed, as well as four rings of the tubbing next below. The joint was finished with an iron ring and cement packing in the same way as in Pit No. 1. The subsequent sinking of No. 2 pit has been suspended until the completion of the permanent pumping-engine in No. 1, when a communication will be made between them. This is due to the fact that a small feeder of water has been struck in a sandstone bed near the top of Coal-Measure.

Cost of Sinking No. 2 Pit.—The following condensed account of the cost of the works shows very clearly the advantage to be gained by the adoption of the method of boring over that of hand sinking when there is any notable influx of water.

		£	£
1.	Sinking through alluvium and upper marls down to 82 ft. including 52¾ ft. of brick walling and 29¾ ft. of cast-iron tubbing:—		
a.	Winding clay and sand, carriage, sinking in marl to 82 ft. drain-supervision, and technical charges	909	
b.	Materials for walling and tubbing and cost of building and erection	1,769	
			2,678
2.	Sinking through fissured marl with cast-iron tubbing, 82 to 200 ft:		
a.	Sinking cost (items as above)	1,485	
b.	Tubbing, inclusive of erection	2,227	
			3,712
3.	Sinking and walling in compact marl 200 ft. to 656 ft.	4,488	
	Total cost down to 656 ft.		£10,878
4.	Boring from 656 to 800 ft. and tubbing 587 ft. to 800 ft:		

		£.	£
a.	Preliminary to boring		255
b.	6¼ ft. bore, 656 to 803 ft.	815	
c.	14¾ ft. bore, to 656 to 800 ft.	1,268	
d.	Tubbing—	£.	
	Various materials	348	
	Tubbing rings	3,565	
	Moss-box	274	
	Bolts and screws	211	
	Wages	465	
		4,864	
	Closing curb	48	
e.	Supervision and technical remuneration	1,149	
f.	Concreting—		
	Materials	440	
	Wages	98	
		538	
			8,882
h.	Depreciation of temporary appliances, boring-machinery, tools, &c.—		
	Boring-frame and foundations	525	
	Engine and boiler	248	
	Various tools	2,065	
			2,838
	Total for the bored portion of the shaft		11,975
	Total for the entire sinking		£22,853

The cost, therefore, from the surface to the foot of the tubbing was £28 10s. per ft; but if the old plan of tubbing up to the top had been followed, the cost would have been about £7,500 more, or about £39 per ft.

Comparison of Cost of Boring with that of Sinking and Pumping.—On the assumption that the footing of the tubbing could have been put in at 764 ft. depth, that the influx of water between 656 and 764 ft. would not have exceeded 3,300 galls. per minute, and that the sinking tubbing could have been carried on at rate of 16 ft. per month, and that no interruption of importance were encountered, the cost may be estimated as follows:

		£.	s.	£
a.	Pumping machinery:			
	2 direct acting engines of 600 H. P. each (effective), with pumps capacle of lifting 4,400 galls. of water from a depth of 771 ft. per minute			23,000
	20 boilers of 1,000 sq. ft. heating surface, with feed arrangements and chimney			12,500
	Steam capstan			500
				£36,000
b.	Pumping cost per day:	£.	s.	
	100 tons of coal at 5s.	25	0	
	Other stores	2	10	
	Wages and supervision	3	15	
	Interest on cost	4	10	
		35	15	
	or per metre (3.28 ft.) of shaft			214
c.	Depreciation of the pumping engines: Assuming one engine and ten boilers to be retained for permanent use, the second engine with the remaining boiler would be depreciated one-half on resale, leaving £9,887 10s. to be provided, or per metre, between 200 and 233 metres.			300
	Or a cost per metre for pumping of			514
	The cost of sinking per metre is	£.		
	" " " tubbing " " "	75		
				150
	Total cost per metre of hand sinking			664
	The sinking and tubbing between 200 and 233 metres at the above rate would cost.			21,915
	And from 233 to 243.9 metres about			300
				22,215
	The actual cost of boring and tubbing under water.			11,975
	Or a saving of			£10,240

The boring between 656 and 800 ft., and the tubbing up to 587 ft., was finished in about a year. If pumping had been adopted, the building of the engines would have occupied about 5½ months, and the actual sinking operations about 7½ months, or about the same time.

Soldering Telegraph Wires Without Cleaning.

M. N. PRISIAJNIKEV, chief of the bureau of mails and telegraph lines of Bongoulma (Russia), according to the *Revue Internationale de l'Ectricité*, has devised a very simple method of soldering bunches of telegraph wires without first cleaning the metal. The solder is first melted in an iron pot and then there is thrown into the melted metal a certain quantity of sal ammoniac, in the proportion of one ounce to one pound of solder. The liquified sal ammoniac soon covers the surface with a black fluid and through this the iron object to be soldered is thrust into the melted metal below. One dip, or at the most two, is sufficient for the purpose. The advantages are that the wires need no previous cleaning even when covered with quite a thick coat of rust; time and trouble are saved, especially in bad weather, and the inevitable wear on the wire by the ordinary cleaning process is avoided.

Size of a Field Party.*

About a year ago Mr. A. W. WRIGHT read a brief paper on the size of a field party for location, which I had hoped to see discussed. It is a subject with which I am not very familiar, my whole experience as locating engineer consisting in the running of a single line in the timbered country of Northern Wisconsin. It was a preliminary line run with a compass, and the party was as follows:

Chief of party, who was also explorer; transitman, two chainmen, and three axemen; levelman, who also took topography, and rodman; cook.

The provisions were all packed in on men's backs, and any possible reduction in number of the party was desirable, as saving cost of getting in provisions. After settled cold weather of winter set in we left our tents behind to save time on moving day. When a man is not in danger of getting wet he will not suffer in open air. Making profile was somewhat troublesome, but we got it done, and the absence of camp stoves and tents on moving day was a relief.

Three men were all we could work to advantage in chopping; an increase led to a wider line of clearing with no gain in progress. The chainman and rodman changed off with disabled choppers. Hind chainman made, marked and carried stakes. Head chainman was also head flagman, kept choppers in line and selected points. Rodman made and marked all benches, kept a "peg-book" with readings on all turning points, and did the necessary extra clearing for levels. As the country was reasonably level and the compass party could not average over 1½ miles per day, it gave the levelman time to take topography, and with assistance of the rodman pace in all section corners. Pacing is abundantly accurate for a preliminary line, and a careful man with practice can pace mile after mile without varying over 50 ft. in any case. I have paced three consecutive miles over fairly rough country, finding two section corners burned and coming out within 30 ft. of the tree at the third.

Three men constituted the pack train. The moving of camp was done by the party, and every man, chief of party, compassman, levelman and cook included, took a load the first trip, and as many as were needed went back for a second load.

It is the opinion of the writer that altogether too much attention is usually paid on preliminaries to precise instrumental work. He recalls an instance in Eastern Nebraska, where a most wretched line in an easy country was run by a full party in charge of a man who had recently been on river work for the United States Army; instrument men were both recent graduates. Preliminary was run from A. to G., and after a short wait the party started at G. and located back to A. I was told that on arrival at A. the alignment checked to 0° 06' and the levels to 0.07 ft. This entire party were faithful and believed they were doing good work; yet how much better for the company building had the line been well laid on the ground and the notes of the two lines widely at variance?

As to instruments and tools: I would take on such work a compass, with open sights, and a good needle; the larger the circle the closer can needle be read. For a level I should choose a light one, and a self-reading rod. On the line mentioned the rod was pine, 12 ft. long, with feet and tenths marked in black on white ground. The Chicago, Milwaukee & St. Paul at one time furnished a rod about 1¼ in. sq. marked as above, but made of maple and supplied with a target with vernier reading to hundreths. It was very convenient.

I would choose a chain with brazed links, not soft enough to break easily on a cold morning, and heavy and hard enough so as not to give too much trouble from bending. Always carry a roll of copper wire with you for mending chains, tripod legs, etc.

*By A. M. VAN AUKEN, Member of the Western Society of Engineers; from Journal of the Association of Engineering Societies.

Lighting Tunnels and Caissons.

The illumination of under-ground chambers—tunnels, caissons and the like—is now usually accomplished by means of candles, oil or electricity. Frequently two of these are combined, an arc light being used for what may be termed general illumination, or the lighting of the center of the chamber, while candles or oil lamps are employed in dark places from which the direct rays of the arc are cut off. Burning oil and candles yield a smoke and an odor which contaminate the air, while the carbon dust arising from the arc lamps is almost as disagreeable. In well ventilated interiors these features are of little consequence, and the adoption of any particular method depends directly upon the cost and the convenience of handling. But in long tunnels, and especially in caissons where there is no ventilation except such as is obtained from the airlock and leaks, it is essential that the light should in no way vitiate the atmosphere.

A most favorable opportunity was recently afforded of comparing these different methods of illumination in the same work, and in which the advantages and disadvantages of each were made apparent.

Four months ago the Hudson River tunnel was lighted by arc lights. Three or four of these were distributed in the heading and adjacent complete work. They merely served to light the chamber sufficiently to enable the men to move about. The men performed their work by the aid of candles, which were most freely used. Owing to the absence of any surface that would reflect light (and in this characteristic the Hudson tunnel is similar to nine out of ten underground chambers) it was necessary to use candles, even when the men were within a few feet of the electric light, provided the rays from the latter did not shine directly upon the work in hand. And when the rays were unobstructed, candles were frequently employed as they relieved the dense shadows cast by the arc. Arc lights were located at the airlocks, and candles were also used there. The arc lights were of no service for lighting the long, stretch of finished tunnel because, owing to the fog, their rays penetrated but a short distance and the glare more than offset the advantages derived. In general, at least nine-tenths of the fog that was ever present was caused by carbon dust floating in the air. Even during a short visit to the heading an appreciable quantity of black dust would be deposited in the nostrils.

Three months since, the arc was supplanted by the incandescent system of electric lighting, and the benefit of the change was instantly made manifest. The fog disappeared and the work was better lighted and at less cost and greater convenience than formerly. In the heading were twenty 16-candle power lamps so arranged that they could be readily moved from place to place as required. Candles were not frequently used. Lamps having sheets of tin as reflectors were distributed at intervals of 50 ft. along the tunnel which was by this means well lighted. Other lamps were placed where needed at the shaft and in the engine room.

The almost total absence of fog was not only apparent to the sight, but was proved by the fact that there was little or no black deposit at the edges of cracks which sometimes formed in the coating of cement applied to the masonry as soon as completed. Through these cracks, which are exceedingly small, the air found a passage, but the dust carried by the slight current was caught by the moisture at the edges and formed a mark, deep black at the edge and vanishing half an inch back. After the introduction of these lamps the deposit in the nostrils was not noticed. The smoke arising from a single candle was easily noticeable in the clear atmosphere, and the fog (dust) created by four arc lights was shown when they were re-introduced for a short time for lighting the heading for photographing.

A marked improvement was found in the handling of the new plant considered as a whole. The lamps could be moved about the heading without trouble, and when a lamp was broken (this did not often occur as they were protected by stout wire cages) it could be easily replaced by any one; further than this they required no attention and caused no expense. The dynamo required no more power to run it than the two operating the arc lights, and in the wear of brushes was decidedly more economical and consequently required less refitting. Another good point arose from the fact that the men were not afraid of handling the lamps, and no one "specially skilled" was delegated to attend to the shifting. Although no special tests or trials were made with either the arc or incandescent plant, the superiority of the latter for interiors where a comparatively small distributed candle-power yields better results than a great concentrated candle-power, was evident at every point from the dynamo to the heading.

The Water Works of Kansas City.

BY G. W. PEARSONS, CHF. ENG. NATIONAL W. W. CO.

The first thing necessary to a description of these works is a description of the city, and this has been given so often that there is danger of the reader getting tired with the preface.

Before the advent of railroads, Westport, a hamlet four miles south of the river, was the starting point of caravans which made their way across the "Great American Desert" of the old geographies, following the divide between the waters of the Kansas and Arkansas rivers to the Rocky Mountains. These caravans lifted the mantle of the supposed desert, and found beneath its folds millions of acres of the finest land on the continent. The great herds of buffalo then covering these plains are replaced by millions of homes with all the accessories of prosperity, requiring the services of railroads and the proximity of a great business center. Kansas City, once Westport landing, has taken this position.

At the close of the war this city essayed to take its place, as regarded business, with the other towns on the river, but they considered that presumptuous. "It was no place for a city—what was not bottom land subject to overflow, was a succession of impassable bluffs and ravines—nothing but a village could be made of it,"—and these views seem to have been held also by the original proprietors, who surveyed a small irregular triangle for a town site, deeding a worthless bit of ravine to the future city for a market square, and with clearer perception of their own needs, a much better square for a burying ground. But the business men of the town, all pulling together, secured the first bridge across the Missouri, the bottom lands gave room for railroads, and in spite of its natural and acquired disadvantages, the city began to climb the hills and put on the airs of a metropolis; other towns have been laid out for cities and became villages, this was laid out for a village and became a city.

All this was not accomplished without the usual western resource of discounting the future; bonds had been given to railroads and for municipal improvements, so that when water-works became a necessity to the future growth of the city, the margin of credit was insufficient to build them and it was necessary to use private enterprise.

Accordingly, propositions were received from various parties, and in October, 1873, an ordinance was passed by the Council containing a provisional contract with the National Water Works Company of New York, for constructing, owning and operating water-works for the supply of the city, and for the suppression of fires by the "Holly" or direct pressure system; which was ratified by vote of the citizens, Nov. 15, of the same year. This ordinance, which was framed on the model of one previously given by the city of Memphis, entirely ignored the different topographical features of the cities. Memphis, lying almost on a plain, being well built up and streets graded so that connecting lines could be laid wherever necessary, the works could fill their requirements equally well in any locality. Here, with differences of altitude of more than 200 ft., with many streets having no existence except on paper, with long reaches of pipe supplying outlying localities, and some of these being on the greatest elevations, the text of section 8 of the ordinance will be of interest to hydraulic engineers:—

"SEC. 8. The company agrees and guarantees that the fire hydrants rented by the city shall at any time with fire pressure in the pipes, throw twelve streams of water through as many different hydrants, in any part of the city, each stream to be through 50 ft. of hose and a 1 in. nozzle, to a height of 100 ft., or eight streams, as aforesaid, through 50 ft. of hose and 1¼ in. nozzle, to a height of 125 ft., or four streams, as aforesaid, through 50 ft. of hose and a 1¼ in. nozzle to a height of 150 ft. * * *." When it is observed that these tests might be called for, on long unsupported lines, three or four miles from the works, and from 200 to 225 ft. above them, without even a provision that such tests might be made on still days, it will be plain that the company had no engineer at the time.

The city appointed Water Commissioners, and the writer was employed by the Water Company to con-

struct the works, their main features having been already determined.

The writer objected to some of the lines located by the Commissioners as being long and unsupported, but was assured that the full tests would not be required on these, as it was only desired to give necessary protection to these outlying localities.

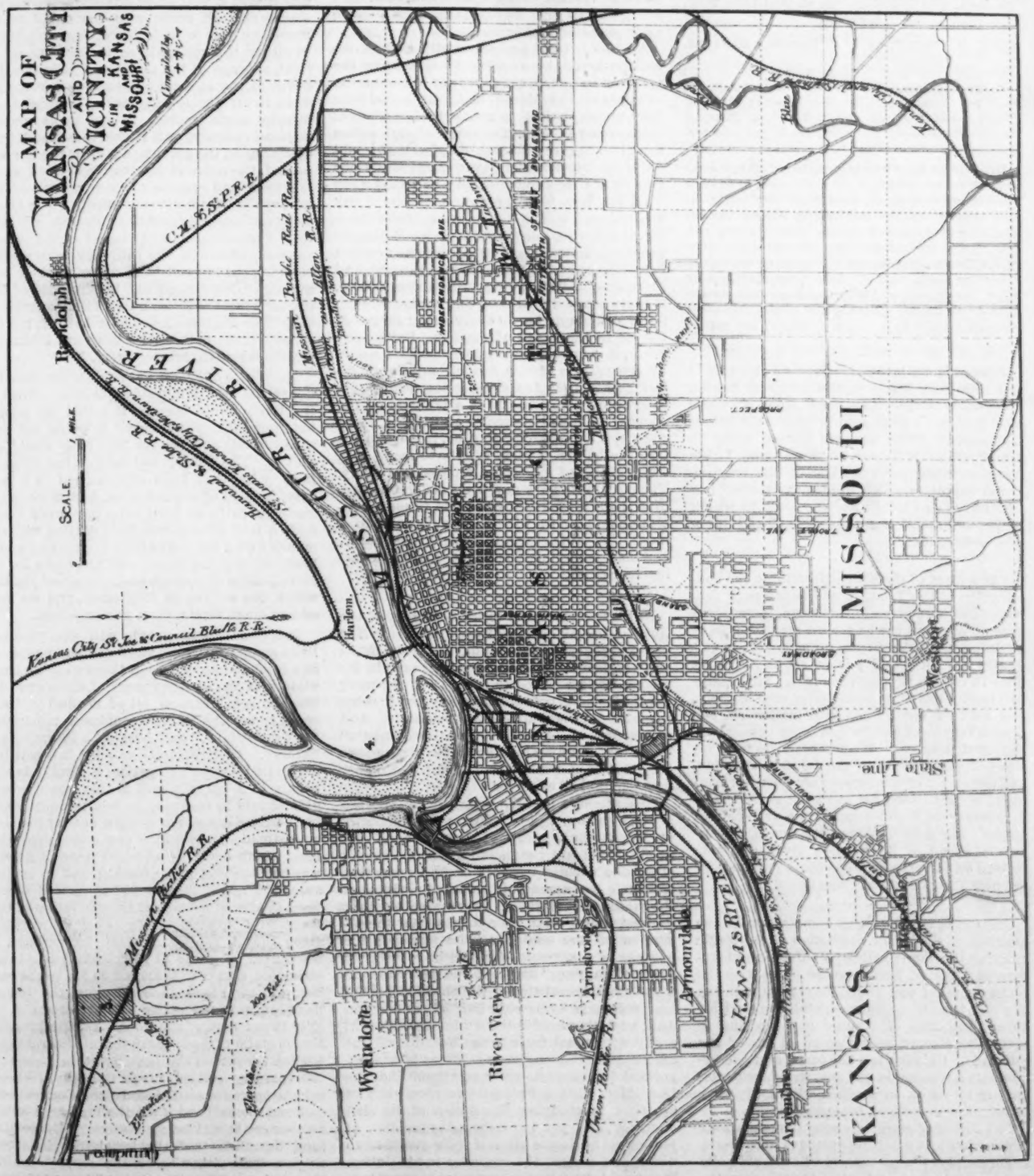
In the early operation of the works, much acrimony existed in quarters where it could be made to do the Water Company essential harm; it made no difference that hose could be burst, and much more water thrown than the meagre fire department of the city could handle; they must have their pound of flesh.

One of the tests instituted by these parties, was on one of these long lines, a 6 in. pipe mile long, fed at both ends but having five right angle bends. Twelve 1 inch streams were thrown from twelve hydrants on this line, and kept going for over three hours, their engineer requiring that time for measurement. All passed the required height of 100 ft.—an incident of interest as showing what can be done with small pipes under stress. The ill-feeling continued till a destructive fire caused the calling of a commission of engineers to condemn the company and their works, the men called being known to favor the use of steamers instead of direct pressure. Their report, however, contained recommendations of additions, part of which the company had already commenced, and showing that the real interests of the city and company were identical, they counselled co-operation instead of war, the people sustained their verdict, and there has been peace ever since.

The foregoing outline of the country, city, company and water-works is sufficient for a proper understanding of the details of construction; in this, the writer not being able to specify cost, is confined to a statement of requirements and the means used to meet them, believing that as these are the largest works in the United States operated by a private corporation and meet some unusual requirements, the work will prove of interest.

NOTE: The above is the preface to a thoroughly descriptive and well illustrated article by Mr. PEARSONS, on the construction of these works. It will pass through probably half-a-dozen issues of this journal.—ED. ENG. NEWS.

(TO BE CONTINUED.)



ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

VOL. XVIII. Saturday, November 5, 1887.

D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

Subscription. — UNITED STATES AND CANADA, $5.00 *per Year*; $2.50 *for Six Months*; $1.50 *for Three Months*; *Single Copies*, 12 *cents*. FOREIGN COUNTRIES, $6.56 *per Year, or* 3 *cents per number additional.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Science in its last issue pays its respects to the New York *Times* on the editorial headed "Is Heavy Artillery Doomed?" and suggests that it secure a good supply of the marvelous *sleetover*, to which we have several times referred, and turn it upon its "funny man." We have probably heard the last of this very peculiar explosive which evades the second law of NEWTON and brings about results in which action and reaction are *not* "equal and opposite in direction."

THE author of the article describing the construction of the London and Southwark subway, elsewhere given in this issue, is surprised that no previous use had been made of iron as a lining for subaqueous tunnels. He is evidently not very well posted as to the work done in the Hudson River tunnel. This American tunnel has long been under construction, and an iron shell, lined with brickwork, has been a very essential feature in its general design and progress. Wrought-iron is used instead of cast-iron, as in the London example, and the action of compressed air, used horizontally, is substituted for the steel shield. But in dimensions, depth beneath the surface and engineering skill displayed, the American tunnel is ahead of its English rival, and was started on the present plans some years before the new Thames subway was heard of.

CHICAGO is moving with some vigor in the question of the better protection of the traffic crossing the many railways entering and traversing that city. But if we can judge from the plans for relief now under discussion, both the city and the railroads are sowing the seed for an endless crop of trouble in proposing to carry the streets over instead of under the railroads. Chicago is a flat town, and the arguments advanced in our last week's editorial on the situation in Buffalo will apply with equal, or even greater, force to Chicago.

The overhead street crossing demands long approaches and resulting damages to property adjoining, and the question of who should build these approaches, and who should pay the property damages, is already the cause of some very acrid talk between the city and the railway managers. The railroads are willing to build the bridges across their tracks and the abutments, but they want the city to assume the responsibility for the long approaches, and also demand that all streets between overhead crossings be closed, and that the city ordinances limiting speed be annulled. Some of the aldermen are very uncertain as to the meaning of the term "viaduct," and want an ordinance passed fixing the exact limits of cost, responsibility and intention of such a crossing, so that when they order a railroad company to build a "viaduct" they shall know what they are going to get. It is evident that no such understanding now exists.

All this trouble and practically useless discussion could be avoided by attacking the question in a proper manner; by following the example of Providence, R. I., and submitting the whole subject to a board of competent engineering experts. The result of such action would be the presentation of a plan that would duly take into consideration present conditions and future requirements, and be based upon what was best for the common interest of city and railroad, and be controlled by neither political influence nor personal ends. While the proposed improvement is really of the greatest benefit to both the railroads and the city, and there should be no antagonism between them, if there is any question of this character, each party could appoint its engineering representatives in the board of experts. But in any event, it is not a question to be decided solely by committees of city council and the financial rather than the engineering heads of a railway corporation. It is a problem of the deepest technical character and if it is to be done well, and done for all time, it must be put into the hands of men who have made such adjustments of interests a professional study. The piecemeal work now proposed in Chicago, even if the authorities can come to some conclusions upon it, will inevitably lead to a tangle that will never fully satisfy either party, and must sometime be undone again at a vast increase of cost.

IN his annual report to the Secretary of the Navy Admiral Porter strongly suggests that our Navy needs remodeling not only in its ships and guns but in its personnel as well. He recommends a complete revision of our navy regulations, and points out defects that in some cases render them almost unintelligible. And among the latter "ridiculous ammendments" upon old practice he particularly mentions the attempted combination of the line officer and mechanical engineer.

This attempt is only equalled by the too ancient custom which places a line officer of the Navy at the head of civil engineers employed at our docks and yards, and Admiral Porter's otherwise excellent report omits to mention this little fact among his proposed revision of the existing regulations. Yet we would suggest to the Admiral that his remarks that the education of the engineer (who manages the engines of a war-ship) can only be secured by "special training," and that "no man can gain a sufficient knowledge of the nautical part of his profession by passing half of his time on deck and other half in the engine-room"—will apply with equal force to the question of line officer and civil engineer. There is one important difference, however, and that is that the line officer does not propose to spend any of his time in studying the duties of the civil engineer; and yet by some peculiar line of reasoning he deems himself fully qualified to direct and control the engineer in his duties. We should think it required quite as much "especial training" to design and build a dry-dock as it did to control a marine engine; and while we heartily approve of the elevation of the marine engineer to his proper and very important and responsible position, we would like to see the civil engineers in naval employ go up with him.

Who Should Pay for Overhead Crossings.

In recent engineering history there has been nothing much more comical than the sudden change of views by the honest yeoman of Connecticut in respect to overhead crossings. With considerable flourish of trumpets a law was passed a year or so ago providing in substance that all grade crossings could be replaced by over or under crossings on petition of either the railroads or the citizens at the joint expense of the towns and railroads, the towns to pay at most one half, and from that down to little or nothing, as the Railroad Commission might decide. It was in no sense a railroad measure, or if it was, that fact did not appear upon the surface; but after the law was passed, the railroad interest, instead of hanging back and opposing the execution of the law, availed themselves promptly of its provisions and pushed operations under it actively, to the amazement and disgust of the honest yeoman, although the railroads were merely carrying out in good faith a law of their own making. One cannot but be reminded of MACAULAY'S famous remark about their ancestors, that "The Puritans hated bear-baiting, not because it gave pain to the bear, but because it gave pleasure to the spectators."

The course of events has made it too clear for doubt that the original strong feeling in favor of the law was not because it suited the people but because it was thought it would not suit the railroads and was the best they would assent to. The painful feeling that the Connecticut citizen has been overreached in a bargain, instead of overreaching, and might have made the railroad companies pay much more, adds a new sting to the bare parting with the money which the towns have to pay, and now a loud call is going up all over the State for an extra session of the legislature to repeal the law which has worked so differently, and we may add so much better, than was expected.

The Connecticut people will get precious little sympathy from right feeling people of any kind and anywhere in these whining complaints at the consequences of their own deliberate act. Almost all of us find it "rare sport to see the knavish engineer hoist with his own petard," and besides, a bargain is a bargain. A deliberately enacted law settling a dispute between two parties is always in the nature of a bargain, and in this case the bargain should be regarded as additionally binding because it was not a hard one for the side which made it and which now complains. The most which could be assessed upon any town was half the cost of a crossing, and from that amount it might range and has ranged downward to almost nothing at the discretion of the Railroad Commission. In practical working since June 1, the Commission has ordered a separation of grade at 22 crossings at a total estimated cost of $108,330, or $4,924 per crossing, and the share assessed upon the towns has been only $20,600, or $936 per crossing, or only 19 per cent. of the total. Yet the preposterous claim is made that even at this rate the burden thrown on the tax-payers in "some of the sparsely settled towns is heavy, (Where are the sparsely settled and poor Connecticut railroad towns?) and if all the crossings shall be changed it will be oppressive." Hence the loud demands that the legislature in extra session shall either throw the entire cost of the work on the railroads (which would probably and naturally have the effect to stop the good work altogether) or that the State at large shall assume the cost now borne by the towns, which is obviously unfair. Hence, also the sudden light which the farmers and townspeople have obtained as to the comparative merits of gates as compared with taking out

grade crossings altogether, the folly of which was so admirably pointed out by President CLARK, of the New York, New Haven & Hartford, in our issue of Oct. 15.

The correctness of President CLARK'S position could not be better illustrated than by the very figures we have just quoted. Gates and flagmen are at best an imperfect, uncertain and partial protection. When only a day flagman is employed, and at night the gates are thrown up and locked open, the protection is rather more dangerous than none at all, for the reason that those who use the crossing become accustomed to the warning of the gates and flagman, and when they reach the crossing a little before or a little after hours, or during the night, the open gates become a lure to lead them to destruction. Very numerous crossing accidents have happened from this cause alone, and happen constantly, for it is still the rule that there is no night flagman at such places, even within the limits of large cities.

A day flagman only, cannot be maintained at a crossing for less than $500 per year. Charging off the cost of maintaining gates against the cost of maintaining an over-crossing, this amounts to 5 per cent. on a capital sum of $10,000, or if a night flagman is also employed, as safety always demands, to $20,000. This is the amount which may be *profitably* spent (regardless of the saving of danger) to take out the grade crossing. There is, therefore, an almost certain money loss in perpetuating grade crossings when it is necessary to employ flagmen, and if we estimate the justifiable expenditure to save a life at $5,000, there are few crossings of any kind in districts at all populous where it will not pay to take out the grade crossings altogether, for a life is pretty certain to be lost at them once in ten years. Even with all the protection of gates and crossings, there are so many lives lost (about 200 in one year) from the Pennsylvania grade crossings in Jersey City that it was found that the pitifully small sum of $300 per life would justify elevating the tracks, apart from the saving in flagmen and otherwise.

Again, although it was quite otherwise half a century ago, the time has long since past when it can be pretended with any reason or decency that our people are too poor to incur all necessary expense to have their roads and railroads made thoroughly safe. Throwing out of account most of the far West, the South and Canada, of which it is still hardly true, the vast region east of the Mississippi and north of the Ohio and Potomac is as abundantly able to meet all such desirable expenditures as any country in the world. Nothing but the bad habits and ideas which are a survival from our days of poverty prevent the work we are considering going on very rapidly indeed, especially in our cities and large towns. But there is already wide and general agitation of the question, and the time is plainly near at hand when a large and increasing amount of such work will be going on in all parts of the country.

Taking it as certain, therefore, that thousands, if not tens of thousands, of grade crossings, in town and country ought to be and in a few years will be eliminated, the great question still remains;— Who ought in equity to pay for the work, the railroads or the towns, or both, and in what proportion? And in considering that question, what has been said about the situation in Connecticut, plainly does not apply, because the objection to the attitude of the people there lies, not in that their present position is in itself unreasonable (which is the point we have to consider) but in the fact that it is an attempt to back out of a deliberately made arrangement by the side which made it.

It cannot be denied that a very strong argument can be made in favor of throwing the entire cost of elimina'ing grade crossings upon the railroads. The people of the United States have been extremely liberal towards their new railroads in permitting them to fall far short of a high standard of construction and safety. That this was done from no particular love for them, but for the more vulgar and selfish motive of encouraging the rapid construction of railroads for the general benefit, does not alter the fact. These railroads are of necessity under a continuing obligation to extend and increase their appliances for convenience and safety with the progress of the community and their own traffic, and the initial laxness does not diminish but strengthens this obligation. Better stations, better rails, better track, greater speed, better cars, better couplers, brakes and heaters, interlocking switches, block signals, and a multitude of such betterments can undoubtedly with justice be enforced by law at the sole expense of the companies, if they are not added without law, as has been the general rule; and no one thinks of asserting the contrary. Why should grade crossings be made an exception, when the necessity for them likewise has been made clear?

That they should not be made an exception is recognized in a measure in many ways by the railroads themselves. The mere fact that they never dream of asking towns to bear part of the expense of flagmen, implies that the over-crossing likewise should be made at their expense, since we have seen that it is generally a money-saving substitute for flagmen. The New York Central elevated tracks at Rochester, the Pennsylvania elevated tracks at Philadelphia and Jersey City, multitudes of over-and under-crossings which are put in every year in various parts of the country, the West Shore elevated track at Newburg and elsewhere, and much other like new work, is or has been all done without a thought of asking the towns to contribute to the expense. The New York, New Haven & Hartford is now taking out a multitude of crossings at its own expense in New York State, and the eagerness with which it is availing itself of the present Connecticut law indicates that it regards it as a very good bargain for itself to get 20 per cent. from the towns. It is now proposed to sink the Harlem tracks in the "annexed district" above Manhattan Island at the sole expense of the road. The costly entrance to the Grand Central terminus in New York City, indeed, was carried through at the joint expense of the city and the railroads, and one of the attorneys for the city at the late Buffalo hearing rather "put his foot in it" and weakened his own case by asserting the contrary. But with the old "Commodore" on one side and the TWEED ring on the other a hard bargain for the city was to be expected, and it was very generally felt and claimed that the city was "gouged" in that arrangement, so that it may reasonably be claimed that the Grand Central case is merely an exception which proves the rule.

Again, it is the general rule of business life that betterments in all private property must be at private expense, even if merely for the public good. A manufacturer may be allowed to do almost anything in the beginning, but as the town improves around him, he is compelled to abate nuisances, to fence his property, to pave the streets and sidewalks, to put in sewers and water-works, to build all additions of brick, and in many ways keep up with the times and the requirements of an advancing civilization, and always at his own expense.

Do not overhead crossings come under the same general head of improvements in private property which were once needless but are so no longer, and may be enforced at private expense? The argument that they do is certainly so strong that, as a matter of law, the railroad companies would have but a poor chance in fighting a law requiring the gradual abolition of all grade crossings at their sole expense, if one were passed in any populous State.

But when we come to the equities of the case the argument on the other side is likewise very strong. Wisely or unwisely—and who can doubt, wisely—the people of the United States have deliberately encouraged and permitted the construction of a vast railroad system which fell in many ways below the the standard enforced in other countries, just as they have permitted large cities to be built chiefly of wood when brick and stone would have been undoubtedly better and safer. By the deliberate consent of the people the typical American railroad crosses all roads and streets on a level if it is possible to do so, and even other railroads. As a consequence, we have obtained in marvellously few years a railroad system of unparalleled magnitude, and the whole country has profited and is profiting enormously thereby. While some of these roads have been very profitable, more of them have been anything but that, and as a whole they have returned but a very moderate profit, which is as nothing compared with the profit accruing to the people at large from the fact of their construction. As nearly as may be estimated, the actual cost of our present railroad system is about 8 per cent. of our total valuation, and its present market value something over 12 per cent. The difference represents a profit of some 50 or 60 per cent. on the investment which has accrued to the railroad companies. But of the remaining 88 per cent. of our valuation, how much would have existed except for the railroads? Certainly not one-quarter; perhaps much less. Fully 60 per cent. of the property in the hands of the people, therefore, has come to them from the railroads, to which the people as such contributed practically nothing. There is much silly talk just now in Connecticut about the 10 per cent. dividends and abundant means of the New York, New Haven & Hartford, but that is about the maximum obtained on such investments, and looking to what the railroads have done for such towns as Buffalo, Chicago and a host of others—in fact, for all our cities—the question cannot but arise in every just man's mind,—have the people a right to demand that these useful public servants shall at their own sole expense change their *type* of railroad in respect to a detail which is almost solely for the good and the safety of the general public, and but very slightly for economy of operation and the safety of passengers? For all new roads the people may justly demand the highest standard of excellence in every detail, in our more thickly settled States, just as cities may demand that all new buildings be of brick or stone in certain districts. But is it equitable to demand that *old* buildings which were built of wood by general consent, shall be rebuilt of brick at private cost, or that *old* roads, built according to the grade crossing standard, shall be rebuilt to a higher standard at private cost?

Certainly this is never done in the case of buildings, and we cannot but conclude that it is inequitable to demand it in the case of the roads, especially if we remember that, in the case of cities especially, the valuation of pro-

perty near the railroads is sure to rise enough by taking out grade crossings to more than cover the expense of the work, even if the city paid the whole expense. What proportion of the expense should be borne by the people is a question into which we have now no space to enter.

The Brooklyn Bridge Problem.

We reprint, in another column, an extract of some length from the New York *Times*, on the Brooklyn Bridge question, partly in order to point out the error in a plan of temporary relief which it suggests, which would really afford no relief whatever, but simply make matters worse, and partly because its sprightly summary of the situation enables us to keep our readers informed without entering into questions which certainly demand discussion, but which, under all the circumstances, we do not care to discuss until the committee of the Board of Trustees, which is supposed to be laboring over the problem of propounding a plan which will stand criticism better than its first one, has actually propounded one in definite shape or has confessed its inability to do so.

It certainly affords curious evidence that the problem presents real elements of difficulty, that even intelligent persons seem to find it hard to understand where the real difficulty lies. Thus, in Mr. EMERY's first report, which was so hastily fathered by the Terminal Committee and the Board of Trustees, the most extravagant claims were made as to a large increase of capacity which it was unmistakably clear, from the context, rested on this simple reasoning: Six-car trains were to be run in place of three-car; obviously, six-car trains will carry twice as many people as three; but also, two starting platforms were to be used in place of one; and anyone who has ever guessed the school-boy conundrum, "What makes more noise than a pig under a gate," can see that twice as many trains can be started from two platforms as from one. But twice as many trains × twice as many people per train = four times the capacity, "obviously." The reasoning is all sound at first thought, but it is not at all sound in fact. When analyzed, the plan gave little, if any, more capacity than four-car trains by the present plan, and that, only by a very dangerous system of operating.

Similarly, the *Times* remarks truly that "any person of large analytical powers, who observes the loading and unloading process at the New York terminus, will see that it is accomplished in three stops. The point aimed at is—with present facilities—to do this in two stops," and the *Times* then proceeds to assert in effect, as a self-evident fact, that it will increase the number of possible trains proportionately, and to propose that the wretched terminal shed, which is already so horribly patched, and so disgracefully ugly and uncouth, shall be still further defaced for that purpose.

Nothing could be further from the truth. Under the present system of operating it makes no difference whether the number of terminal stops be three or thirty, nor whether the cars are switched directly from the unloading to the loading platform or make a trip to the Battery in the mean time. A few more trains may have to be in service in the one case than in the other, but that is all. The limit to the capacity of the bridge, and the only limit, is simply the number of trains which can be stopped at the unloading platform, unloaded, and hauled away from in front of it. What becomes of the trains thereafter has no effect on capacity, for the reason that loading can be done more quickly than unloading. And if, by combining the loading and unloading in a single stop we increase the time required for the joint operation over that for unloading, we only *decrease* the capacity of the bridge by so much, however many subsequent stops we save.

The present time allowed for unloading, and hence the headway between trains, is 90 seconds, of which 10 seconds is for the stop, 10 for getting under way again, 40 for the actual process of unloading, and 30 a margin for safety, which is found to be often required. This margin may safely be diminished a few seconds by some form of automatic protection for the rear of trains, but as the saving cannot be great, and applies equally to any system of operating, we may for present purposes throw it out of account.

This accepted, it follows from the preceding that there is but one way to increase the capacity of the bridge, *to increase the number of cars per train*. It is susceptible of absolute demonstration that the maximum number of cars per train, and the maximum safety as well, can only be obtained under a circulating system, the trains chasing each other round and round on an endless track. As we have already stated in these columns, there is no difficulty under that system in handling 14 or 16-car trains with little if any change in the present cable mechanism, and with but slight addition to the operating expenses per train, these long trains being unloaded within a station extending no further east than the present one, and no further west than the east line of Centre street instead of extending over and across that street, and with numerous and important further advantages, into which it does not now seem an appropriate time to enter. In the curious "letter of instructions" to the Board of Experts, which the Terminal Committee have recently assumed the authority to appoint, (but which has so far held no meeting and had nothing laid before it except in an irregular way to single members) the Terminal Committee expressly state that the plans which they have to submit, or Mr. EMERY through them, are limited to the handling of 6-car trains, which is certainly a strong indication that their labors, since the first unfortunate proceedings, have been guided by little wisdom or breadth of view. The Terminal Committee however, at present have the floor. They cannot with any dignity and propriety evade the duty, for which they were granted time at their own express request, of submitting definite recommendations and plans. When they have done so, or have confessed their inability to do so, it may appear proper for us to have something further to say in the matter, as we certainly will if any such absurd plans are recommended as are outlined in the instructions to the Board of Experts. Until then, we have nothing to say, except to express the hope that hereafter there will be more appearance of regard for the public interest, and less of regard for some unknown and invisible private interests, than there has been heretofore.

The Proper Tamping of Drill-Holes.

The late editorials on this subject were prompted by the results of some foreign experiments with clay tamping with black powder and by those of Prof. MUNROE with the peculiar effects obtained in exploding gun cotton on iron plates. The deductions as to the effect of an air-space over a charge of some high explosive, were founded on theory alone, and were sent abroad with the hope that someone having actual experience might see fit to answer.

We now find that the trial has actually been made essentially upon the lines laid down in the remarks referred to, and that the result has been so successful that it was covered by a patent some years ago. While not in the habit of lauding a patented device, this particular case has a personal interest in confirming theories of our own, and has a general economical interest that makes it worthy of further comment and perhaps further improvement.

In rock-blasting the best effect implies the thorough lateral breaking of the hole as far below the collar, or mouth of the hole, as possible, and a lifting and shattering of the rock, with the least projection from the site of the hole possible. Rock thrown to a distance means power wasted, and probably a waste of explosive as well, in-so-much as combustion may not be perfect and the full power of the gases be undeveloped. The usual practice is to load the drill-hole with a charge proportioned to the work to be done and then to immediately cover the powder with a tamping driven hard; or, in the case of nitroglycerine, to use a water tamping. The effect in both cases is the same, and the gases first developed are at once compelled to act upon a relatively small area of the drill-hole and against the resistance of the hard tamping filling the remainder of the hole; if the tamping is properly applied, the action and reaction should be equal, and the resulting effect would be the expenditure of the full energy of the gases of explosion upon the portion of the hole containing the charge. Any percentage of energy not utilized in breaking the rock, is wasted in projecting the tamping and rock fragments to a distance which practically measures this loss of power.

On the other hand, if an air-space of say twice the linear dimensions of the charge intervenes between the charge and the hard tamping at the mouth of the hole, it is reasonable to expect an increased effect from the explosion. The gases are developed with an almost immeasurable velocity, and the fact that they have three times the space to fill before they are met by the resistance of the tamping, will decrease their pressure per lineal inch of hole to some extent, but the enormous power still remaining is exerted over just that much more surface of hole, and that is the direction in which we must look for useful rending effect. This rapid flow and pressure of the gases over an increased surface would explain the bursting of a gun-barrel with a wad jammed half-way down, or by having the muzzle accidentally filled with snow, as in the case which caused the inventor of the device under discussion to experiment in that direction. And it would appear that the higher the power of the explosive and the quicker its action, the better it would be adapted to this method of treatment.

Practical observation led to the trial of an air-space in the drill-hole, and the results, as reported, certainly showed a great increase in effective work. The method ordinarily adopted was to charge the hole and cover the charge with a light tamping with a detonator in place; above this, originally, leaves, or some other loose material, were put in and covered with a small amount of dry earth, and then near the mouth of the hole the tamping was driven in as solidly as possible. Dry and very coarse sand over the charge was also found to answer an excellent purpose, and furnished an effective air-space, provided that there was no water in the hole. In a wet hole, this coarse sand, enclosed in a parafine paper cylinder, did very well if the rough sides of the hole did not tear the paper in entering or tamping. Water was fatal to the increased effect sought, as it is practically inelastic, and had all the effect of solid tamping. In practice, these air-spaced holes broke very low down, in some cases leaving the collar of the

hole unbroken and the tamping at the mouth of the hole intact; the rock was lifted, but not projected, to any distance, and experiment long continued showed an actual saving in explosive and general cost of nearly 20 per cent. As an example, taken from the reports of the Chief of Engineers, U. S. A., 1870-1882, it is found that in the James river work, granite rock was taken out, by this method, under 18 ft. of water, for $4.15 a cubic yard, total cost, including superintendence. Exactly similar work in Gowanus bay, in a like depth of water, cost $3.81 per cubic yard for *explosives alone*.

The patent referred to covers the supply of an air-space by means of loose tamping over the charge, or by a loose rod providing an annular space, and it seems to be in extensive use in the Eastern granite quarries, and in the sandstone and other dimension-work quarries of Pennsylvania, and the testimonials as to the economical effect and increased power are encouraging. As it is used there, however, in connection with a peculiar reamer intended to control the direction of fracture, and we see no account of its trial in ordinary blasting operations, other than those mentioned on the James river, we cannot say what it would do in general contract work. But we see no reason why the air-space would not apply there as well as in the other case, with economy of explosive and a decrease of danger from flying fragments. The inventor of the combined air-space and reamer patent is Mr. C. L. KALMBACH, who has had long experience in rock-work, in the Government service especially, and was in charge of the blasting operations on the James river referred to above.

Just now we are doing a very considerable amount of street-blasting in this city, and the current practice is not altogether unaccompanied by danger to buildings and general traffic. In fact, heavy curtains of logs and other covering do not always prevent the projection of rock from the trench. It would seem that a method that breaks well below the collar and shatters without throwing to any extent, is peculiarly applicable right here. Just how far the trial can be made without infringement on a patent, we do not know, not having seen the text of the patent, but it would seem that the air-space alone was hardly a patentable feature; or it might even pay, in any event, in better results for less explosive. It appears to be worth trying.

The Red River Valley Railroad.

Probably no railway enterprise of the present season has caused a more wide spread interest than the Red River Valley Railroad. This has been largely due to the political and sectional interests which were involved in the enterprise, but those are matters for others to discuss. The chief benefit which the projectors and supporters of the enterprise hope to secure, is merely the lowering of transportation rates which is supposed to follow the building of competing lines; and the motive for its subsidizing and support by the Manitobans is thus, after all, the same which is advanced for municipal aid by nearly all promoters of new railway enterprises in this country. In considering this, the question of what is justly due to existing corporations is one which receives no more attention in the United States than in Manitoba; and the people of the province have only followed out the ordinary principle of self interest in taking no thought for Canadian Pacific stockholders. Of late the financial troubles of the enterprise have been the principal obstacle to its completion; but in spite of these, and the combined opposition of the Dominion Government and the Canadian Pacific corporation, it is likely that the desired competing line will be obtained.

Neither of these latter bodies deserves any great blame for its opposition. The company's legal rights were infringed and its attempt to protect them was nothing more than any person or corporation would make. The attempt of the Dominion Government to keep good its contract with the Canadian Pacific, was likewise its simple duty. But under the circumstances now existing in Manitoba, both opposing parties will act wisely if they allow the construction and operation of the competing lines to go on, and let the Government make such financial reparation to the Canadian Pacific for the damage it will suffer as is its just due. The people of Manitoba suddenly became impressed with the belief that they would obtain a great reduction in transportation rates by having a competing railway; and when a community becomes infected with that idea, the new line is pretty certain to be built. It matters not that existing transportation rates are down to actual cost, or that they are no higher than in localities similarly situated. A very large proportion of men are under the impression that since a railway train is "going along," and it doesn't cost any more to give their persons or goods "a lift," that the sum exacted for fares or freight is a sort of imposition. It is easy to persuade these people that the railway corporation which they are accustomed to patronize, is a monster monopoly which is swallowing up their hard earnings and choking boa-constrictor fashion the proper growth of their own private business.

This class of people are not moved by reason, and to aid needless competing roads and boom real estate prices, they will vote enormous burdens of taxation on their municipality for the next generation to pay. In speaking thus we do not wish to be understood as condemning the new Manitoba road. We merely wish to show that it is pretty certain to be constructed whether necessary or not; and while its benefits will probably be much less than its promoters have imagined, the development of the province will doubtless furnish plenty of business for both it and the Canadian Pacific. Neither do we wish to object wholly to the use of the principle of competition as a means of securing equitable rates. What is most objectionable is the great drain upon the world's wealth caused by the construction of needless parallel roads. It must soon be understood that the attempt to permanently keep down rates by competition is to be defeated by the conditions under which corporations act, and some more permanent and equitable means must be sought for securing just rates of transportation.

The Brooklyn Bridge Problem.

We reprint the following lively comment on the Brooklyn Bridge passenger traffic from the New York *Times* of Oct. 31, partly because it very correctly sets forth the urgency of the situation, and the extraordinary way in which a great public question is being dealt with, and partly because it sets forth a plan for temporary relief, which would really afford no relief at all, and hence well illustrates that the problem of dealing with this great and novel question properly, is not quite so simple a one, as it has appeared to the writer, and to some others who have dabbled in it:

The scenes daily witnessed by those who ride across the Brooklyn Bridge between 5 and 7 in the afternoon cannot be duplicated elsewhere, not even on the uptown platforms of the elevated railways. The struggles to get aboard—nobody attempts to get a seat except by chance—resemble a series of "scrapping matches" more than anything else. Some fight with the ever-ready policemen; others wrestle among themselves in the doorways, each one making entrance with a pop as audible as the extraction of a champagne cork. No man of adult dignity enters that human maelstrom with even a chance of preserving his back and stomach from desecration by extraneous elbows. No woman there dares to hope that sex or weakness will protect her from physical collisions, which often are so violent as to be dangerous, and are always personally offensive. We ask no individual's pardon for remarking in a general way that only persons of considerable strength of body and rather weak minds would engage in that sort of thing day after day. They must be strong for otherwise they could not survive it. And they must be weak minded or they would demand a remedy in tones which would be understood even by the obtuse managers of the busiest railway throughfare in the world.

"We are aware that something resembling reflection over this deep problem is going on among the unrelated ganglia wherein the intelligence which directs the bridge affairs must be taken to reside. We remember that something like a year ago, solemn counsel was taken of a much-bepuffed expert. The oracle delivered itself, and straightway sundry other experts rent the deliverance asunder. Months sped by and sundry other guaranteed experts were invited to expose themselves to jealousy and ridicule. They made no sign of progress until, within a day or two, one of them resigned. Two of them appeared in no haste to proceed when they were unsuccessful in what looked like an attempt to freeze out the third. He in turn took less interest than the two associates in attaching the bridge railway to the elevated systems at each end. It is as fit and evident that these solutions of continuity should grow together as that severed snakes and fish-worms should do so in the fashion so familiar to small boys. But everybody knows that traffic agreements are much harder to engineer than any problem of mere railway management. Nothing is clearer than that both bridge terminals must be wholly rearranged. But that is a big, expensive job, requiring months of time and many thousands of dollars. We submit that any one in possession of anything resembling an idea as to how these millions of passengers may be better accommodated meanwhile, has no right to keep it secret. They should confide to their newspaper in confidence. There is no use in communicating it to the bridge authorities. They show little sense of their own and less appreciation for the happy thoughts of others. It was not until after a year's prodding that they built a gutter after plans and specifications propounded by us. But they did it. For months they declared it was simply impossible to transfer passengers to the Brooklyn Elevated Railway. But they are doing it triumphantly every day. They have not yet widened the platform on the New York side, but they give signs that they see the point. Meanwhile we propound to them the following easy one:

"Any person of large analytical powers who observes the loading and unloading process at the New York terminus, will see that it is accomplished in three stops. That is to say, there is a stop to discharge passengers, a stop in the process of switching, and a third stop to take a load aboard. The point aimed at is—with present facilities—to do all this in two stops. The "headway," or time between trains, is under two minutes. The time necessary to load a train is under one minute. Therefore, if it were possible to save say half a minute, it would be equivalent to adding, roughly speaking, one-third to the headway. That is, more trains could be run, with a proportionate increase of accommodation or more time could be allowed for loading.

"If the person of large analytic powers as aforesaid happens also to possess large powers of synthesis—no allusion is intended to the intelligent persons who manage the bridge—he will observe that each car has two sides, and that each side has three exits. He will also observe that the cars are loaded and unloaded on opposite sides. He will next note that the two operations are separate when they might be simultaneous. In that case it would only be necessary to stop the cars twice. The only missing link is a platform whereon disembarking passengers might land. Why not build it?

"The best coon dog is usually the most "ornery-looking pup." This is not an expert's plan. It is not even patented. The bridge people won't want it because it don't cost them anything. Nevertheless, we make bold to ask the various reasons why, during the "rush" hours, it would be impossible to discharge passengers from Brooklyn through the center doors upon a platform built over the promenade and communicating eastwardly with the street, while, at the same moment, passengers for Brooklyn were stepping aboard precisely as now. Of course, Brooklyn passengers for the New York elevated railway would be discommoded a little. But they are a mere handful compared with the throngs going to Brooklyn during the afternoon "rush" hours. The greatest good for the greatest number is the rule. There is height enough for headroom between the promenade and the proposed platform above it, which it would surely be

easy and cheap to build. Let the overworked Trustees, and the honorable President, and the excellent Superintendent think of this."

PERSONAL.

JULIUS DEXTER was elected, Nov. 1, as President of the Cincinnati, Hamilton & Dayton R. R., to succeed A. S. WINSLOW.

Gen. J. T. DODGE has resigned as Chief Engineer of the Montana Central Railway. Mr. E. H. BECKLER has been appointed his successor.

Mr. CHARLES C. UPHAM, Chief Engineer of the Chicago, Burlington & Northern R. R., has been appointed Superintendent of the Illinois lines of the Chicago, Burlington & Quincy R. R.

Major R. C. MCCALLA, Chief Engineer of the Tuscaloosa Northern R. R., was seriously injured Oct. 25 at Tuscaloosa, Ala. In getting off a moving train on the Alabama Great Southern R. R., he slipped and fell under the wheels.

Mr. JOSEPH WOOD, who has held the position of Superintendent of Motive Power of the northwest system of the Pennsylvania Company, has been appointed General Superintendent of Transportation and Vice General Manager.

JAMES MCCREA has been elected Fourth Vice President and General Manager of the Pennsylvania Co.; JOSEPH WOOD is appointed General Superintendent of Transportation; EDMUND YARDLEY, Superintendent of Transportation; F. D. CASANAVE, Superintendent of Motive Power, and GEO. L. POTTER, Master Mechanic of the same company.

Mr. JOHN B. CORNELL, the head of the firm of J. B. & J. M. CORNELL, of New York City, manufacturers of structural and general iron work, died at Lakewood, N. J., on Oct. 26, at the age of 66. Mr. CORNELL was born at Far Rockaway, L. I., and was trained in the iron foundry of his brother, whose firm was CORNELL, ALTHOUSE & Co. In 1847 he and his brother WILLIAM embarked in the business under the firm name of J. B. & W. W. CORNELL; WILLIAM died in 1870 and the firm of J. B. & J. M. CORNELL was then formed.

Mr. C. H. MEEK, at present Superintendent of the Des Moines division of the Wabash Western Railroad, and also of the St. Louis, Des Moines & Northern Railroad, has been appointed General Manager of the new Denver, Texas & Fort Worth Railroad, the total projected length of which is about 1,300 miles. The 800 miles from Denver to Fort Worth are to be finished early in 1888.

THOS. U. WALTER, died in Philadelphia on Oct. 30., aged 84 years. Mr. WALTER was President of the American Institute of Architects, and one of the leading architects in this country. He designed and carried out the extension of the capitol at Washington in 1850, built the wing to the Patent Office in 1851, and was the architect of Girard College in Philadelphia, the latter noted as one of the purest specimens of Greek architecture in this country. Among other of his more noted works were the construction of the Congressional Library, the U. S. Treasury Building, the U. S Post Office and the dome of the capitol building, all in Washington, D. C. Of late years he has been connected with the Public Buildings of Philadelphia.

The EDISON phonograph, long considered merely as a curious toy, is said to be so far perfected by its original inventor that it will have a commercial use as a substitute for the stenographer and type-written letter. In the new form a merchant has only to talk into the machine and his actual words and tone of voice are impressed on a sheet, or "phonogram," which can be mailed in an especially prepared box and sent as a letter. The receiver puts this phonogram on his machine and the message is spoken to him in its entirety. The machine is propelled by an electric motor and the reproducing sheet is practically indestructible so that it can be used many times.

Gen. A. W. GREELY, U. S. A., in his first annual report upon the U. S. Signal service, calls for immediate improvement in the military signalling system, which is practically the same as that in use 25 years ago. Careful experiments will be made in the coming year with homing pigeons as a means of communication between distant points. Trials will be made with them between Key West and Cuba. He points out the many advantages to be derived from the successful adoption of better signalling practice in time of war.

CORRESPONDENCE.

A Broken Locomotive Parallel Rod.

TROY, N. Y., Oct. 25, 1887.

EDITOR ENGINEERING NEWS:

The parallel rod of Locomotive No. 72, of the Rome, Watertown & Ogdensburg Railroad Co., which was drawing a special train conveying President and Mrs. CLEVELAND from Clayton to Alder creek, broke July 16, 1887, when running at a speed of from 35 to 40 miles an hour, killing the engineer. Having been requested by the N. Y. State Railroad Commissioners to examine a piece of this rod, the writer did so with the following results:

The rod was of wrought-iron one and three-quarters (1¾) by three and five-eights (3⅝) ins. in section, the piece submitted being nine (9) ins. long. The two 1¾ in. edges were rounded irregularly, by striking the ties and cab after the accident, as may be seen on Fig. 1, which shows the broken end, at *x*

Fig 1.

and *z*, and part of the center of the fractured area was also beaten smooth at *y*, *y*, as if projecting fibre had been crushed down. Almost surrounded by this beaten down and rounded surface was a flaw of irregular shape, approximately 1 sq. in. in area, extending to one of the longer edges of the rod on one side near its center.

Microscopic examination showed decided evidence of crystalline structure at the points marked *a*, *b*, *c*, and *d*, in the figure, in fact, this was clearly visible to the naked eye, and traces of cinder were also found. The remaining portion of the broken section not crushed down, though not crystalline, did not show well developed fibrous structure but the edges were in nearly all parts broken sharply off.

The other end of this 9-in. piece, which had been nicked and broken from a longer piece of the rod, is shown in Fig. 2. The fracture is fibrous though the welding is imperfect.

For testing, the material was cut into four pieces, three of these having two (2) ins. of the middle of their length turned to sections three-quarters (¾) of an inch in diameter for tensile tests, the fourth being broken by bending. Those broken in tension gave results found in the following table:

Mark.	Diameter. Inch.	Area Sq. in.	Lbs. per Sq. In. Elastic Limit.	Lbs. per Sq. In. Ultima'e Resistance.	Elonga. in 2 ins. per cent.	Diam. of reduced sect. in.	Reduc'n of area per cent.
1	0.749	0.441	29700	49200	19.0	0.682	24.3
2	0.748	0.439	32500	48500	17.2	0.673	18.9
3	0.749	0.441	27200	43200	14.0	0.710	10.2
Mean.	.....	.....	29800	46970	16.7	.....	17.8

These are evidently not what should be expected from iron used for such a purpose, the percentage of elongation and reduction of area being particularly small. The fractures were reasonably fibrous, as shown in Fig. 3, but it will be seen that there is a seam of considerable size opened in each one of them, the welding parallel to the flat side of the bar being imperfect. The piece broken by bending checked at 90° and broke at 150°, the fracture being reasonably good.

A mean of two chemical analyses made by Dr. WM. P. MASON, gives, phosphorus 0.0853 per cent. and sulphur 0.0120 per cent.

As is always the case, no evidence exists that this iron had been changed by use, but, on the contrary, it is believed, from careful examination, that it was originally of the same character as found.

As to the frequency of accidents like this one the general conclusion to be drawn from the answers of superintendents of motive power of some of the larger railroads of this country to inquiries on this

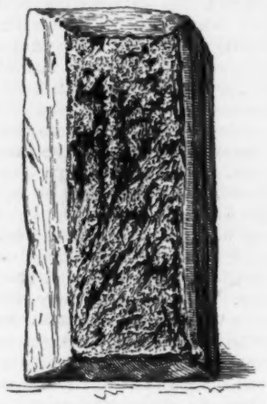


Fig. 2.

point is, that on the older fast engines, with small rods, such breakages are not infrequent, but that since larger rods have begun to come into use their number has been largely reduced.

Whilst the ratio of the number of parallel rods broken to the total number in use is small, the number broken in the aggregate is not so. A superintendent of motive power writes me: "As regards breakages, I find that with a locomotive mileage of 72,604,576, thirty-four bars have been broken, all of iron, not one steel bar having been broken since their introduction in 1876. It is but fair, however, to state that a portion of the iron bars broken were of inferior design." As, however, nearly all of these rods were probably broken on fast engines, the proportion of broken ones is probably much greater than the above figures show. Another superintendent says: "Many of the old engines are equipped with a light rod which was never strong enough for the service required, and these break frequently. They have, however, been gradually replaced on two or three railroads with which I have been familiar with side rods of a heavier pattern, none of which have yet been known to break, so far as I am aware.' The Superintendent of a road using 228 engines

Fig. 3.

says: "Since May 1, 1880, our books show seven new side rods to replace broken ones." In this case, also, the rods were probably broken on fast engines.

When the probable consequence of a broken rod is considered, it would seem that they would be made of such size and material that the number of breakages would be reduced to practically none, and from statements coming from roads using such rods only, this can be done. Although the tendency at present is to increase their size, rods of 5 ins. in depth, either of rectangular or eye-section, being now common on fast locomotives, there unfortunately remain on many of the older engines the smaller sizes. In fact the use of rods of the size and kind of this broken one, is common for some classes of passenger locomotives on many roads. A knowledge of the nature of the material, with its possible flaws not detectable by external examination, and of the great stresses to which it is subjected, especially those alternating ones due to the inertia of the bar at its lowest and highest positions, makes obligatory the statement that such sizes on locomotives with considerable wheel base, which run at high speed, should not be permitted. Although theoretical considerations would call for a larger rod, a rectangular section five (5) by one and three-quarter (1¾) ins., has prac-

tically been found sufficient for such engines; a better, though more expensive shape, being the I section, which made four and three-quarter (4¾) ins. deep with two and a half (2½) in. flanges, has worked well on some roads in this country.

With regard to the best material to be used, it may be said that it has not yet been proved by experience that steel is superior to iron for this purpose, though it has given satisfaction in many cases and will probably replace it. One of the largest locomotive works in this country still makes 90 per cent. of its rods of hammered scrap-iron, steel being used only when specified. Respectfully,

PALMER C. RICKETTS.

What is a Cantilever Bridge.

Engineers' Camp near Danielsville, Ga.
Oct. 27, 1887.

EDITOR ENGINEERING NEWS:

Whence comes the term "Cantilever" as applied to bridges; or in other words what is a Cantilever bridge? Be so kind as to give us an illustration of such a bridge. A.

This is a question quite frequently asked and we might as well answer once for all. The term, as applied to a bridge, is of comparatively recent origin, but the principle is as old as the Hindoos and the art of building itself. It has been applied to wooden bridges for centuries, and it is only its later scientific solution by modern builders of steel and iron bridges that has brought it forward again prominently. Its advantage over other forms of truss construction is, that by a proper method of anchoring or balancing and the arrangement of its tension and compression members, it can be erected over space without supporting falseworks. The Niagara and the Forth bridges are the latest examples of its application to a site where the conditions made false works impossible, or very expensive. Our issue of Jan. 11, 1887, shows the neatest illustration of the principle of such construction. BRANDE, in his Dictionary, gives the possible origin of the term as being *canterii labrum*, the lip of a rafter. In its simplest form it is a beam, or a series of beams, projecting out over space and weighed down at the inner ends. And by pushing out two such series of beams from either bank of a stream and spanning the space between their ends with a plank, the Hindoos have built bridges from time immemorial.

Another Engineer Wanted at Auction.

PORT CHESTER, N. Y., Nov. 1, 1887.

EDITOR ENGINEERING NEWS:

Another auction railroad. I received the enclosed "notice" a few days ago, and as it was somewhat of a novelty to me, wrote for the "particulars and information" referred to.

You may have them; some of your readers may want them to bid. I don't. Yours, J. M. F.

The "notice" is as follows:

Vincennes, Oakland City & Owensboro R. R.

J. C. Rudd, President; Edward Watson, Vice President; C. W. Brandford, Secretary; W. A. Olephant, Treasurer; J. B. Cockrun, General Solicitor.

OWENSBORO, Oct. 20, 1887.

NOTICE.

Wanted an Expert Engineer to survey the line of the Vincennes, Oakland City & Owensboro R. R., from Owensboro, Ky., to Vincennes Ind. For particulars and information, apply to JAS. C. RUDD, Prest.

The letter of "particulars" referred to was headed as in the "notice" and read as follows:

DEAR SIR:—

Yours of 20th received, and in answer will say our road is now open for bids, and a number of them already in. So all I can say is for you to send in your bid for survey, construction and profiles. Have it in on or before Nov. 10, 1887. Length of the road is abou 65 to 70 miles, through a good country free of rocks, etc.

Yours respectfully. * * *

[About the only comment to make on the above is best put into the form of a query; and that is, whether the railroad company, so well officered, obtained its President, Vice President, Secretary, Treasurer and General Solicitor in the open market by a similar competitive method to that proposed for its engineer? The "particulars" make no reference to previous experience or testimonials, and it appears to be a question of "bid" only that is to decide the appointment of one who will have a very great deal to do with the success or failure of the prospective railway. If the road is built on the location of the lowest bidder, the bondholders have our sympathy.—ED. ENG. NEWS.]

The New York Elevated Railways.

ST. LOUIS, Mo., Oct. 15, 1887.

EDITOR ENGINEERING NEWS:

Will you kindly favor me by answering the following questions, viz.:

1. Do the elevated railway companies, of New York City, contemplate using electricity as a motive power?

2. What did the New York Metropolitan Elevated Railway cost per mile of double track ready for operating, including station houses?

3. What is the cost per annum of maintenance of the Metropolitan Elevated Railway double tracks?

4. What was the original cost of rolling stock per mile. Yours truly J. B. CLEMENTS.

[In answer to the first of the above questions: while some experiments have been made with electric motors by those interested in the "L" roads, there is little likelihood that as long as steam locomotives are permitted to be used in the city streets, any other form of motor will replace them. In the present state of steam engineering it is, speaking broadly, almost always more economical to use separate engines in each locality where power is required than to use a single large engine and transmit the power by any form of mechanical or electrical device. As to the nuisance of steam motors running overhead in crowded streets, New Yorkers have become so accustomed to it, and it seems so mild and gentle when compared with a number of our other obnoxious nuisances that it will probably be a long time before any effective protest is made. To the various questions regarding cost, we are unable to make very accurate replies, and are of the opinion that it would tax the ingenuity of a Pacific railroad investigator to find substantially correct answers. In the New York State R. R. Commissioners' report the cost of road and equipment of the Metropolitan Elevated Co. is given at $21,818,000, or $1,179,092 per mile of track. This is merely a sum obtained by adding together the total amounts of outstanding stocks and bonds. In view of the well known facts concerning the excessive dilution which this stock has suffered, the only mathematical relation which we feel safe in asserting between the above figures and the actual cost of building and equipping the road is that expressed by the sign of inequality with its open end very widely open toward the above sum.

From Poor's Manual we find that the item of Maintenance of Way on the whole Manhattan Elevated system for the fiscal year ending Sept. 30, 1886, was $322,115.90. The system includes 32.4 miles of double track lines, which makes the annual expenses per mile about $9,940. It is probable, however, that under this item is included additions and repairs rendered necessary by the increase in traffic and weight of rolling stock, so that the figures do not give a correct idea of permanently maintaining the structure and road. In reply to question 4, we find that the cost of rolling stock on the New York Elevated was $1,445,831. The line built for this company was 13.6 miles in length, which gives a figure per mile of $106,311.

If our correspondent desires these figures as a guide in making any professional estimates, we would warn him to use them with caution, for, with all credit to the technical skill and ingenuity which has been exercised in the construction and operation of the elevated railways of this city, they are much more wonderful from the adroit financiering that has accompanied them than they are as monuments of engineering skill.—ED. ENG. NEWS].

From a Stockholder in the Keely Motor.

EAST GREENWICH, R. I., Oct. 15, 1887.

EDITOR ENGINEERING NEWS:

Referring to enclosed extract from your journal, I have been a stockholder in the Keely Motor Co. for many years, and have never been called upon to pay any assessments. The stock is not assessable.

I do not believe in the Keely motor any more than you do, but I like to see every man treated fairly, JOHN W. KEELY included, and in this I am sure you agree with me. Respectfully,

W. BRENTON WELLING.

[The enclosure is an extract from our issue of Oct. 8, to the effect that:

"KEELY has a rival, and had better make another assessment on his stockholders and give an exhibition of his motor at once. The new aspirant to fame is a Mr. L. C. WELTNER, of Uniontown, Pa.," etc.

We give place, with pleasure, to the correction, which seems to indicate that this now widely known motor approximates to the miracle of perpetual motion in more ways than one.—ED. ENG. NEWS].

"The Mechanical Equivalent of Heat."

The late experiments on the "Mechanical Equivalent of "Heat, by Messrs. COWPER and ANDERSON, and given in a paper read before the British Association, are of especial interest and value from the fact that they were conducted on an unusually extensive and perfect scale.

In attempting to improve upon or test the results of Dr. JOULE, the authors sought to employ a powerful machine that would absorb a large amount of power, and keep it going for an entire day at a time, and to eliminate all loss or gain from radiation or conduction. After much study of the subject they concluded to use a Froude dynamometer, such as are used in testing the power of marine engines, and fitted up as follows:

A large tank was provided, made of wood and well lagged outside with three thicknesses of hair felt, and a smaller wooden tank was placed inside of this containing the dynamometer. This protection was found so good in practice that the tank of water only lost 1° of heat in 8¼ hours, when standing. Two very large thermometers were made, each about 3 ft. long, having graduations of ⅛ in. to 1°. These were used in taking the temperatures of the cold inflowing water and the hot outflow; other thermometers were used in the outside tank to enable it to be kept at the same temperature as the inflowing water. The object aimed at was to employ continuously about 5 horse-power, and heat a gallon of water per minute to about 20° Fahr., with the effects of radiation and conduction neutralized as much as possible.

Without going into the details of the experimental apparatus, further than to say that they kept the water, etc., in a normal state for many hours together, the result may be given as follows: As found by the experiments, the "Mechanical Equivalent of Heat" was 769 ft. lbs., that is to say, that 1 lb. of water raised 1° Fahr. was equal to 1 lb. lifted 769 ft.

Prof. JOULE'S "equivalent" was 772 lbs., and the authors say that the fact that their result was slightly lower is not to be wondered at when it is considered that in their apparatus all losses of heat were prevented, and had not to be calculated; nor did the specific heat of the apparatus enter into the calculation, as this was kept in a normal state throughout the experiment.

THE Westinghouse exhibition freight train has repeated in Cincinnati the successful tests reported in last issue.

Progress on the New Croton Aqueduct.

The official report of Chief Engineer B. S. CHURCH gives the progress on the New Croton Aqueduct, to date of Oct. 22, as follows:

Miles of tunnel excavated to date	28.8147
Miles of open cut excavated to date	1.1103
Total miles excavated	29.9250
Total miles unexcavated	.9258
Total length of tunnel	30.8508

The work done, and to be done, as divided among the several contracts, is as follows:

	Headings Excavated.	Unexcavated.
	Lin. ft.	Lin. ft.
Brown, Howard & Co.	65,469.9	615.0
O'Brien & Clark	50,391.5	3,976.0
Heman Clark	24,132.0	0.0
John Brunton & Co.	11,597.0	303.0

The total advance made in the week ending Oct. 22, in 10 headings, was 299 lin. ft. The maximum weekly advance was 40.8 lin. ft. as the average of 4 headings on Brown, Howard & Co.'s work, and the minimum was 18.8 lin. ft. as the average of 4 headings on the work of O'Brien & Clark.

The headings still furthest apart are between Shafts 13 A. and 13½, 882 ft.; 13½ and 14, 1,383 ft.; 17 and 18, 498 ft.; 24 and 25, 1,109 ft., and 27 and 28, 303 ft.

The condition of the masonry, on Oct. 22, stood as follows:

Lineal Feet of Masonry Laid, Oct. 22, 1887.

Class of Work	Brown, Howard & Co.	O'Brien & Clark.	Heman Clark.	J.Brunton & Co.	Total Aqueduct.
Invert	22,311	4,352	17,343		44,006
E. Wall	46,358	32,469	1,880	None	80,707
W. Wall	50,506	32,522	1,880	as	84,908
Arch	42,078	28,668	16,687	yet.	87,433

Lineal Feet of Masonry Still to be Laid.

Invert	44,058	50,009	6,789	11,900	112,756
E. Wall	20,010	21,892	7,425	11,900	61,228
W. Wall	15,862	21,839	7,425	11,900	57,126
Arch	24,290	25,693	7,425	11,900	69,309

Since our last official progress exhibit of July 16, 1887, 1,316 miles of heading have been driven.

The original contracts called for the completion of the new aqueduct on Sept. 30, 1887, but for reasons already stated the Commissioners lately extended this time eight months. The following table shows the percentage of work completed on Sept. 30 last:

Contractors	Per cent. exca.		Per cent. completed.			
	Headings.	Bench	Invert.	Side walls	Arch	Total Lining
Brown Howard & Co.	98	89	28	66	58	53
O'Brien & Clark	92	74	4	56	50	41
Hem. Clark	100	90	75	67	66	71
John Brunton & Co.	96	80	0	0	0	0
Tot. Aque't.	96	83	24	58	52	47

An Engineer's Banquet.

A very elegant banquet was recently given by the engineering staff of the Chicago, Madison & Northern Railroad to their chief Mr. ISHAM RANDOLPH. The entertainment was given at the Hotel Holland, Rockford, Ill., on Monday evening, Oct. 24. Covers were spread for about fifty guests, including the principal engineers and contractors of the Chicago, Madison & Northern extension, and other officers of the Illinois Central Railroad.

The tables were arranged in the form of a hollow square, in the center of which was an elaborate floral piece, representing the steam shovel of contractors RYAN & MCDONALD. Over 1,000 roses and 2,500 carnations were used in making the piece, besides many other flowers. The deck of the cab was made of Marshal Neil, and bride roses; the wheels of Garfield carnations; smoke stack, night carnations; all the machinery, pink carnations; cogs, niphetos roses; ends of cylinder, Marshal Neil roses; platform, pink carnations. On the four sides were "Chief Engineer—Isham Randolph—Rockford—Dodgeville" in blue immortelles. The crane and scoop shovel were made of sweet elysiums and roses. In the scoop were placed button hole bouquets for each of the guests.

As Mr. RANDOLPH took the seat at the head of the table, he was presented by Principal Assistant DAVID SLOAN, on behalf of the engineer corps, with a gold watch and chain appropriately engraved. When Mr. SLOAN had concluded his presentation speech, he was in turn surprised by receiving a similar gift which was presented on behalf of the corps by Mr. P. R. HARRISON.

The repast was followed by several speeches, and at a late hour the company broke up, well pleased with the kindly and fraternal spirit manifested on the occasion.

PUBLICATIONS RECEIVED.

A Text-Book of Inorganic Chemistry.—By Prof. VICTOR von RICHTER (University of Breslau). Translation by EDGAR F. SMITH, Professor of Chemistry, Wittenberg College, Springfield Ohio. Philadelphia, 1887; P. Blakiston, Son & Co., Publishers. Size, 5 × 7¾ in.; pp. 423; 90 illustrations. Price, $2.00.

This is the third American from the fifth German edition and is extended over previous editions in the section devoted to the thermal behavior of bodies and rather greater attention paid to the dynamical side of chemical reactions. The sections upon the pressure and condensation of gases, and upon dissociation phenomena, have also been increased and new facts introduced. Otherwise the characteristic features of this long accepted work remain unchanged and the increasing American demand for it warrants the success with which the work of Prof. RICHTER has met abroad.

Elementary Treatise on Analytical Mechanics.—By WILLIAM G. PECK, Ph. D., L. L. D., Professor of Mathematics, Mechanics and Astronomy in Columbia College. New Edition, 1887. A. S. Barnes & Co., Publishers, New York. Price, $1.65.

The fact that this work is the accepted text-book in so excellent an institution as the Columbia School of Mines is a sufficient endorsement of its merits. The work is especially intended for the uses of the Engineer and Architect; it is clear in its expression and well arranged and while the higher mathematics are employed to a considerable extent, the elementary processes of analysis are not neglected. It is, of course, particularly well adapted to class use.

Recent Advances in Electricity, Electric Light, Magnetism, Telegraphy, Telephony, Etc.—Edited by HENRY GREER. Illustrated, College of Electrical Engineering, New York, 1887. Size, 9½ × 6 in., pp. 54, Price, $1.00.

This pamphlet seems to be a series of extracts from various publications giving brief notes on the newer discoveries in electricity. While in some cases these extracts are full, in others they are too brief to convey especial intelligence to any but an expert.

Chadwick Lead Works, Catalogue and Diagrams, Boston, Mass., 1887.—This is a trade circular, but contains a number of tables and full-sized diagrams relating to lead pipe that will be useful to parties interested in water distribution, etc. There is also a tabular statement of water-works in the United States, with the size and weight of lead pipe used in connection with a given head. Other tabular matter in the Catalogue is selected with especial reference to the needs of water-works superintendents, etc.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—Regular meeting of Nov. 3; President WORTHEN in the chair, and a large attendance of members and visitors. The Secretary announced the death of Mr. EUGENE F. FALCONNET, elected member June 3, 1874, and of Mr. FREDERIC W. VAUGHAN, elected Member Feb. 17, 1869; it was directed that the usual Memoirs be prepared. The Secretary read the report of the Committee on Nomination of Officers, and the names presented for the next annual election were as follows:

President, THOS. C. KEEFER.
Vice Presidents, J. J. R. CROES, ROBT. MOORE.
Secretary, JOHN BOGART.
Treasurer, GEO. S. GREENE.
Directors, MENDES COHEN, JOS. M. WILSON, STEVENSON TOWLE, CHAS. B. BRUSH, ALPHONSE FTELEY.

The following proposed amendments to the Constitution and By-laws were then presented, noting only the changes as made in those already printed in our issue of Oct. 8.

Amend Art. XVI. As before printed with the addition to the second clause—"* * excepting the right to hold office or vote upon admission to membership, or changes in the Constitution and By-laws of the Society:" and in the third clause "There shall also be a preparatory grade to be designated Students of the Society, who shall have the right to receive the transactions of the Society, and to present papers and written discussions. They shall also have the right to use the library and rooms of the Society, and to attend its meetings subject to such regulations and restrictions as the Board of Direction may adopt, etc."

Amend Sect. XVII., by adding in second clause, "An Associate Member shall be one not less than 24 years of age, who has had actual practice in some of the branches of Civil, Military, Mining or Mechanical Engineering for at least five years, or has graduated at a school of engineering and been in practice two years and who continues in actual practice at the time of his application for Membership.

"An Associate shall be one not less than 25 years of age who is—etc."

A Student shall be one not less than 18 nor more than 27 years of age * * * * * his connection with the Society shall terminate at the end of 7 years, or upon his attaining the age of 27 years.

Amend Sect. XVIII, as follows: "Nominations and proposals for admission to the Society, except to the grade of Student * * *. The proposals for Member Associate Member or Associate * * *."

Amend Sect. XIX, by adding after the first clause: "In the election of Students by the Board of Direction one negative vote shall exclude the applicant."

Amend Sect. XXVIII, by adding to the end of the first clause. "A Student may be summarily expelled by a majority vote of the Board of Direction at any time."

Amend Sect. 19 of By-laws by inserting the words "Associate Member" and striking out the word "Junior."

Another amendment to Sect. XVIII of the Constitution provided that applicants for Membership "not residents of North America," and not personally known to five Members could have their names submitted to ballot upon the endorsement of five Members of the Board of Direction.

Sect. XIX. was also to be further amended by adding as follows:—"The Board of Direction, upon receipt of letters from not less than eight Members in good standing, requesting a reconsideration of the proposal of any rejected candidate, stating the reasons for the request, may, if he considers the reasons to be sufficient, order another ballot to be taken; whereupon the Secretary shall mail to each Member, whose address is known, a notice of the same, with a letter ballot, in such form as shall be prescribed by the Board of Direction, and requesting the recipient to vote thereby, or in person, on the day appointed by the Board to canvas the ballot. The ballot shall be an open ballot, and five or more ballots, cast in the negative, shall exclude. The Board shall designate a regular meeting, at which the ballot shall be canvassed, which meeting shall not be less than 25 days after the Secretary has issued the notice mentioned."

Sect. XIX. was to be further amended as follows:—"Members shall be elected by the Board of Direction by an affirmative vote of two-thirds of the members thereof, in case of the non, etc., etc."

The paper of the evening was on "The Transferring of the Cables of the Niagara Railway Suspension Bridge," and was read by the author, Mr. L. L. BUCK, Member of the Society, who designed and carried out this most important and interesting piece of work. Space permits in this place only a brief sketch of the methods adopted. The original towers were of masonry and their height from the rock foundation was 80 ft. and 90 ft. respectively for the opposite sides of the gorge, and they were 15 ft. square at the base and 8 ft. square at the tops under the saddles. The limestone masonry commenced to show signs of failing some years ago, and at about one-third the height of the towers from the top bad cracks appeared, Mr. BUCK was then called to examine and report upon the cause and best means of remedying the defects. He ascribed the damage to the actual bending of the stone piers under the elongation and contraction of the cables from changes of temperature and conditions of traffic, and the resulting excess of pressure upon the facing stones opening the joints and admitting storm water into the pier. As a temporary expedient he advised the cutting out of the damaged masonry and its replacement with sound stone and a thorough filling of the cracks with cement and grout. This work was done in 1883, but before long cracks again appeared and it became necessary to adopt more radical measures of repair.

Mr. BUCK was again called upon, and as a result of his report it was decided to remove the masonry supports altogether and substitute towers of steel and iron. The pressure upon each of the four towers was practically 900 tons, and the delicate operation of transferring this weight to new supports was as follows: The four corner posts of the new metallic tower were first erected outside of the stone pier and connected transversely to each other and the pair of towers braced together. The tops of these main posts terminated some distance below the old saddle, and they were there capped transversely; on these caps four strong cast-iron columns, placed at the corners, supported another pair of caps, which in turn carried two sets of longitudinal lifting beams, one located over each saddle of the two cables. Under these lifting beams was a curved link held by pins in the ends of the beams, and carrying a series of small cast-iron saddles. In the heavy casting of the old bridge saddle were originally a series of vertical holes and these were rounded with a chisel so as not to cut the wires which were to be used in connecting it with the link of the lifting beam above.

The wire lashing used was No. 8 cast-steel wire, which was passed in a series of straps through the

holes in the main saddle-casting and over the small saddles on the link above. When this was done six hydraulic jacks, three at either end of the saddle, gradually raised the upper caps carrying the lifting-beams, and thus raised the saddles and the cables off of their bearings on the rollers beneath. As they were raised thin shims of iron plate were put between the upper caps and the four cast-iron columns in such manner that when the jacks were released the columns transferred the load of the cables to the new metallic tower. The rollers and old bed plate were then removed, the masonry cut down to the tops of the four main permanent posts, and the permanent longitudinal bearing truss of built beams was slipped in between two of the cast-iron columns, moving on the axis of the bridge, and when this was permanently connected with the metallic tower and its proper bed-plates, roller, etc., put in place, the hydraulic jacks were again called into requisition, and the old saddle with its cables was permanently lowered on to its new supports.

All that then remained was to carefully remove the old masonry from the heart of the new tower, and put in the longitudinal and transverse bracing as the masonry was taken down. The Detroit Bridge & Iron Works built the towers, and the author referred to the excellent quality of their work, and the great care shown, and the valuable assistance rendered by the foreman of erection. Mr. BUCK answered many questions of detail after reading the paper, and Mr. THEO. COOPER voiced the sentiments of the Members present in remarking that despite the very modest manner of description and the apparent simple character of the final design, the achievement from an engineering standpoint was one that American engineers, and especially Members of the American Society of Civil Engineers, should be very proud of as the boldest work of its kind ever accomplished or attempted.

The following were declared elected:

FOR MEMBERS:

GEORGE EARL CHURCH, Civil and Consulting Engineer, London, England.

HENRY STEVENS HAINES, Chief Engineer and General Superintendent, now Chief Engineer and General Manager, Savannah, Florida & Western R. R., and Chief Engineer and General Manager "Plant System, S. F. & W. R. R. Savannah, Ga.

DAVID CARLISLE HUMPHREYS, Adjunct Professor of Applied Mathematics in Washington and Lee University and U. S. Assistant Engineer with Missouri River Commission, St. Louis, Mo.

WILLIAM DATUS KELLEY, Jr., Special Assistant Engineer on New Croton Aqueduct, Tarrytown, N. Y.

ROWLAND ROBINSON MINTURN, Assistant Division and Locating Engineer, Chicago, Milwaukee & St. Paul Ry., Milwaukee, Wis.

JAMES MOYLAN, engaged in general practice of Civil Engineer, New York City.

CORNELIUS PALMER, Superintendent of Bridges and Buildings, Chicago & Northwestern Ry., Escanaba, Mich.

WILLIAM BARCLAY PARSONS, Consulting Engineer, New York City.

EDWARD FESSER PLAYLE, Assistant Engineer in charge of Shafts Nos. 21, 22 and 23, New Croton Aqueduct, Morris Dock, New York City.

ALBERT FOWLER ROBINSON, Denver & Rio Grande R. R.; Assistant Engineer in charge Chicago & Alton R. R: Assistant Calculator for Kellogg, Bridge Engineer Chicago, Burlington & Northern R.R., St. Paul, Minn.

ORLANDO BELINA WHEELER, engaged as U. S. Assistant Engineer in charge triangulation party under Missouri River Commission, St. Louis, Mo.

FOR ASSOCIATE:

ARTHUR JAMES MOXHAM, President Johnson Steel Street Rail Co., Johnstown, Pa.

FOR JUNIORS:

ARCHIE MCLEAN HAWKS, Assistant Engineer Randolph Bridge, Chicago, Milwaukee & St. Paul Ry., St Louis, Mo.

DOWNING VAUX, engaged in Bureau of Sewers, New York City.

Engineers' Club of Philadelphia.—Record of regular meeting, Oct. 15, 1887. Past Pres. FREDERICK GRAFF in the chair: 20 members and 1 visitor present. Mr. A. MARICHAL presented a description of the Gileppe Dam, Belgium, illustrated by photograph and drawings, and followed by a discussion having for its object to prove that a saving of 50 per cent. of masonry could have been effected, together with an increase of stability, by adopting a profile taken from his "Diagram for the Construction of Reservoir Walls," presented to the Club on May 21, 1887.

Mr. A. SAUNDERS MORRIS presented notes upon "Connections for Secondary Batteries." Arrangements for connecting the elements of storage batteries have given some trouble, principally on account of oxidation. The best form of connection is one in which the joint is removed as far as possible from the acid, and which can be readily detached for the purpose of removing the element.

Several forms of binding posts or connections were exhibited, made of tough lead alloy. Both male and female threads are cast so that the castings are turned out of the moulds, completely finished, at the rate of one per minute. The mould for casting the screws was also exhibited.

The Secretary presented, for Mr. W. H. NAUMAN, a description of "Tests for Riveted Joints, made at Watertown Arsenal, Massachusetts, for the Bureau of Steam Engineering, September, 1886," accompanied by very complete drawings and tables. Mr. HENRY ROESKE, of Philadelphia, introduced by the Secretary, presented an illustrated description of a system of water filtration, devised by him. He preceded this description by a historical sketch of the filtration of water and the various principal devices which have been used for the purpose of accomplishing it. Mr. ROESKE's filter consists of a series of compartments so arranged that a large excess of water can be used for agitating and cleansing the filtering material in each compartment separately, while the rest of the compartments are furnishing a continuous supply of filtrated water. The material in each compartment is designed to be cleansed at intervals of hours or days, as may be desired, by the action of automatic valves, which are operated by a lever, formed of pipes, which fills with water at the designed intervals, and by its thus increased weight operates the valve. Sand and coke are the materials used. They are placed in separate compartments, the design being to protect the coke from the coarser impurities, so as to lengthen the time of its use. It is intended that the coke be used, also, as fuel after removal from the filter.

Liverpool Engineering Society.—The usual fortnightly meeting of this Society was held on Wednesday, Oct. 19., Mr. JOHN J. WEBSTER, M. Inst. C. E., President in the chair. A paper by Mr. C. HARRISON TOWNSEND entitled "Ornament and Design, their Relation and Subordination in Engineering Works," was read by the author. The author commenced by defining the works forming the subject matter of his paper. He half apologized, speaking as he did to engineers, for adopting Mr. RUSKIN's definitions of Architecture and Building; he thought they covered the ground and begged no controversial question. He proposed to illustrate the conclusion he had arrived at by means of two specimen pieces of work, entrusted severally to the engineer and the architect. He instanced the line of thought which would pass through the engineer's mind when entrusted with the design and construction of a viaduct across a valley, and by diagrams illustrated the probable outcome of his design. The result of such a piece of engineering work, though now-a-days often pleasing to the eye and taste, he was unwilling to give the engineer credit for. The mellowing touch of time and nature's beautiful surroundings were to be thanked for what we now admire in the aqueduct across the Campagna as well as in certain modern railway viaducts he instanced. As opposed to the engineer's work he imagined an architect and his process of design when treating, say a cathedral. The requirements were many, and all these first of all had to be met. The simple building of a series of unconnected parallelograms in fact would meet material wants, but the true architect is not satisfied with this. He insists that every part of his building from lofty roof to carved boss should be pregnant with meaning and with a message to man. All architecture is charged with something "to say," and even bad architecture that tries thus to speak but utters nothing coherent nor really of service to man, is in so far better than the work (skilfully constructed though it may be) of him who builds "and there's an end on't." The lecturer showed by diagrams how "thought" on his designers part, and interest in the spectators mind underlie even the simplest detail of a true architectural building. He concluded by pleading that from the savage, with his painted birch canoe, upward throughout the human race there was a desire for beauty, and pointed out that his strictures had been directed against such works of the Civil Engineer as palpably and in many cases wilfully disdained this need in man.

Connecticut Association of Civil Engineers & Surveyors.—The Fall meeting of the Association will be held at the office of C. H. BUNCE, Hartford, Conn., on Wednesday, Nov. 9. The programme is as follows:

10.30 A. M. 1st paper. "The Preparation of Submarine Foundations," by GEO. W. FULLER, Submarine Engineer, Norwich, Conn. 2d paper. "Adjustable Effluent Pipe, Middletown Water-Works," by E. P. AUGER, Civil Engineer, Middletown, Conn. 3d. Question Box.

2.00 P. M. 1st. Discussion on the "Rental Value of Hydrant Service," opened by C. E. CHANDLER, Civil Engineer, Norwich, Conn. 2d. Visit to various objects of engineering interest about the city of Hartford.

Members are requested to send any questions they desire answered to the Secretary, D. S. BRINSMADE, Birmingham, Conn.

New England Railroad Club.—The regular monthly meeting of the Club will be held on Wednesday, Nov. 9, 1887, at 7.30 P. M.

Subject for discussion, "Material for Axles, Journal Bearings and Lubrication."

CONSTRUCTION NEWS.

Water.

Proposals for Water Meters.—The Water-Works Committee of the Corporation of Manchester, England, will receive proposals for water meters until Nov. 21. Particulars of tests, forms of tender and other information, may be obtained of Mr. T. H. G. BERREY, Town Hall, Manchester.

The Jeter & Boardman Water & Gas Co. has been incorporated by W. A. JETER, of Brunswick; A. E. BOARDMAN, J. W. WILCOX, and others, of Macon. The company has a capital stock of $50,000, and will build and operate water-works, gas works and electric light plants.

Superior, Neb.—The city will build water and electric light works jointly at a cost of $35,000. The plans are being prepared by JOHN W. NIER, Civil and Mechanical Engineer, Kansas City, Mo.

Failure of a Stand-Pipe.—On Oct. 27, the stand-pipe of the water-works at Seneca Falls, N. Y., burst, and the flood caused considerable damage. The pipe was 30 ft. in diameter and about 130 ft. high; its thickness at the place of fracture is said to have been ⅝-in. The accident is attributed to bad quality of the plate. The loss to the company is estimated at $25,000.

Railroad Water Supply.—The Terre Haute (Ind.) *Gazette* says the water supply on the Vandalia still continues to be short, but the most of the difficulty is experienced on the west end. The supply at nearly all the tanks on the middle and west divisions has given out, and the company has been obliged to haul water from St. Louis and Greeneville, where the supply is derived from the water-works, to the tanks where no water can be obtained. The hauling is being done in the Union Tank Line oil cars, three of which are hauled from the above named cities daily.

White Plains, N. Y.—In consequence of erroneous statements that have been circulated regarding the water supply, Mr. A. L. FASSETT, Superintendent of the Water-Works, has published the following report made by Mr. ISAAC S. CASSIN, C. E., of Philadelphia, Pa., and dated June 4, 1887: "I have just completed tests of the yield of water from the well from which the Westchester Water-Works Co. obtains water for the supply of White Plains, N. Y. The well is 17 ft. in diameter and obtains water from a depth of about 30 ft. The water rises in the well to 2 ft. below the surface of the ground. A suction pipe of 12 ins. diameter extends from the well to the pumps. The tests were made with the pumping engine of the water-works. The result of the several tests shows a yield of 414,720 galls. per 24 hours. Assuming that this well has a present capacity of 400,000 galls. per 24 hours, it seems clear that its minimum yield must exceed the amount called for in the contract with the village (250,000) and as it has been demonstrated that water in abundance can be secured by this means, a further or additional supply may be added whenever required. The water is of unusual brightness and purity, and there seems no doubt the people will take it in paying quantities."

New Water Works.—*New York.*—Newark. The works are approaching completion; the pipes are being laid and the reservoir and stand-pipe are nearly finished.——Albany. Work on the conduits for the new supply will probably not be commenced till next spring.

New Jersey.—Montclair. The water company has laid 22 miles of mains and is now constructing the reservoir. There will be a daily supply of 226,000 galls. from a well.

West Virginia.—Weston. Water-works are projected. ——Wellsburg. The works have been in operation about a year and the tax receipts more than pay the running expenses. The pressure is sufficient for fire purposes.

Kentucky.—Winchester. Propositions to build the new works will be submitted.

Georgia.—Albany. The Albany Water-Works Co. will have a capital stock of $30,000 or $50,000.

South Carolina.—Spartanburg. The Spartanburg Water-Works Co. has been incorporated by Moffett, Hodgkins & Clarke, of Watertown, N. Y., E. A. Burlingame, of Providence, R. I., and others, with a capital stock of $100,000. Moffett, Hodgins & Clarke have the contract for the construction of the works.——Columbia. It has been decided to put in a system of water supply at a cost of about $18,000.

Ohio.—Coshocton. The vote on the water-works question resulted in 419 for and 27 against. The contract has been let to the American Water-Works & Guarantee Co., of Pittsburg, Pa.

Indiana.—Plymouth. At a vote on the question of a system of water-works, the proposition was carried by a majority of nine.

Illinois.—Belleville. In consequence of the recent low stage of the water the company has directed the engineer to prepare plans for a larger storage reservoir and an additional supply.——Princeton. The

vote on the appropriation of $5,000 for an artesian well was 522 for and 82 against the appropriation.——Jacksonville. Steps will be taken to ensure a better water supply.——Paxton. The new works are progressing. The water will be pumped to a tank 20 ft. high, standing on a brick tower 80 ft. high. The mains are being laid. ——Lewistown. The Lewistown Water Co., has been incorporated by LEWIS W. ROSS, A. M. BARRETT, and others, with a capital stock of $25,000.——Bloomington. An additional supply of water from 7 tube wells, 8-ins' diameter and 60 ft. deep, has been added to the water system.

Iowa.—Knoxville. The city is putting in a new system of water-works.

Wisconsin.—Hayward. Water-works are under construction and will cost from $15,000 to $20,000. As the place is not incorporated as a village, all Sawyer county will be taxed for the cost of the works.

California.—San Diego. W. S. HOWLAND has contracted to sink an artesian well on Coronado beach, for the Coronado Beach Co., and give a supply of 2,000,0.0 galls. per day. The company will pay $30,000 if he strikes water, gas or oil in 3,000 ft.——Hayward. Two large wells are being dug and the water will be pumped through 5,000 ft. of 5-in. pipe to reservoirs on the hills. WM. HAYWARD and WM. KNOX are each putting in a well and a reservoir.

Texas.—Brownwood. The water-works were tested Oct. 25 with satisfactory results. With a pressure of 130 lbs. a stream was thrown over the court-house.——Fort Worth. The Galveston *News* says the financial condition of the water-works is bad and that there is a disposition to lease them to a responsible party who will successfully operate them.

Nashville, Tenn.—Work is progressing rapidly on the new water-works. The filter on the island, which has been under construction for 2 years, is now finished. The masonry of the wells and engine house is being built, and is now far enough advanced to be safe from interference by the river. A 36-in. main laid on the river bed leads the water from the filter to the pump well, the bottom of which is 16 ft. below the bottom of the river. The masonry and buildings are expected to be completed, and the erection of the pumping machinery commenced in November. The pumping plant will consist of Gaskill engines, furnished by the Holly Manufacturing Co., of Lockport, N. Y. Work is also in progress on the reservoir. Whitsett & Adams are the contractors for the filter and reservoir; Hicks, Holmes & Co., of Nashville, Tenn., are the contractors for the masonry. Mr. ED. MEAD, formerly city engineer, is in charge of the work.

Report of the Water Commissioners of Cobleskill, N. Y.—The Board of Water Commissioners of the village of Cobleskill, N. Y., have issued their first annual report, dated August 1, 1887. The Board was organized June 15, 1886, its members being the same as the Board of Trustees of the village. In July, 1886, Mr. WM. N. ROBERTS was engaged as Chief Engineer and he remained in charge until the works were practically completed in July of the present year. In answer to the advertisements, seven proposals were received for the construction of the works, and the contract was awarded to Stanton & Doyle, of Cohoes, N. Y. The contract for the cast-iron pipe was awarded to the Warren Foundry & Machine Co., Phillipsburg, N. J., being the lowest of the four bidders. The Mathews hydrants and Eddy valves were adopted. The distribution system comprises 6,539 ft. of 4-in. pipe, 4,530 ft. of 6-in., 2,872 ft. of 8-in., 11,162 ft. of 10-in., 2,110 ft. of 12-in., 187 ft. of 16-in. and 169 ft. of 20-in.; aggregating about 5¼ miles of mains, on which are placed 44 hydrants. The engineer's report is appended. MARTIN D. BORST is President of the Board, and GEO. D. HARDER, Secretary.

Galveston, Tex.—The City Council has accepted the proposition of Mr. MORGAN JONES to lease the water-works to the city for another year; his terms are $585 per month. For operating the water-works the following bids were received: C. E. Johnson, 1st, without revenue from private consumers, $600 per month; 2nd, with private supply cut off, $422; 3rd, receiving revenue from private supply, $415. Jos. Duddy and C. F. Ruhl, 1st, without revenue from private consumers, $545; 2nd, with revenue, $445; 3rd, city to furnish fuel, fireman and repairs, $180. Contract made with C. E. Johnson for $415 per month.

Mr. J. D. COOK, of Toledo, O., who was offered the position of Chief Engineer for the proposed new water-works, has accepted the appointment and will be in Galveston this month. It is intended to issue the advertisements for proposals and let the contracts by January. Mr. COOK reported upon the new works, to be built with the $450,000 made available under the new charter, when the city first determined upon a supply of which the present salt water system was intended merely as a forerunner. The new supply will be from artesian wells.

Nebraska City, Neb.—On Nov. 3rd the city celebrated the completion of the system of water-works (which was officially tested that day), the laying of the corner stone of the west abutment of the great bridge for the Chicago, Burlington & Quincy R. R., to be built across the Missouri, and the recent acquisition of the Missouri Pacific R. R. The order of the exercises was a procession from the City Hall to the site of the bridge, the laying of the corner stone, an address by Hon. J. STERLING MORTON, procession to the City Hall, dinner, official test of the water-works, and a ball in the evening. N. B. LARSH is Mayor.

Machias, Me.—Referring to the new water-works which were mentioned on p. 302, Mr. ROSE writes as follows:

70 DEVONSHIRE STREET,
BOSTON, MASS., Oct. 31, 1887

EDITOR ENGINEERING NEWS:

Your blank for Statistics of New Water-Works Construction, addressed to me at Machias, Me., is at hand. There has nothing been done about water-works at Machias, except preliminary survey and estimate made by me the last of Sept., 1887. It is rather probable that they may, at an early day, organize a company and proceed with the work. They have a grand opportunity for utilizing a natural supply from springs, 105 ft. above the level of streets at Court House and 125 ft. above streets at Custom House, by simply building reservoir and piping. Will retain your blank, and if I do anything further with the project, will give you such information as I may be able to.

R. ROSE, C. E.

Smith's Falls, Ont.—During the past year the town has grown considerably in importance and about $350,000 have been spent in buildings and improvements; of this amount about $100,000 have been expended by the Canadian Pacific Ry. in the erection of the depot and roundhouse and in other improvements for the benefit of the Montreal Air Line, the engineering headquarters of which are now located at this place. The railway company has introduced a system of water-works and three hydrants are taken by the town. The iron bridge being built by the Government will soon be completed and the incandescent system of electric lighting will be in operation in a few weeks. About $7,000 have been spent on streets, sidewalks, public wells, etc. A very large number of houses have been erected, and many more are to be built next season. Among other improvements announced for next year are the extension of the railroad buildings and the erection of a hotel by J. M. McLaren at a cost of about $10,000.

The New Pumping Engines at Chicago, Ill.—The following is the report on the new engines:

CHICAGO, Ill., Oct. 29, 1887.

HON. GEO. B. SWIFT,
Com. of Public Works, Chicago, Ill,

SIR:—The undersigned, the Committee appointed by you to make a trial of the new Gaskill pumping engines now in operation at the North Side pumping station, beg leave to submit the following report of the results obtained.

A trial of each set of machinery was made, beginning on Monday, the 24th inst., with the west pair of engines, the trials being of 24 hours duration each, that period having been adjudged, by the Committee, sufficient to settle the questions referred to it by the city. A supplementary trial was also made of the engines first tested, to determine the efficiency of the boilers, and the distribution of heat in the engines. The data obtained, and the calculated results, will be submitted in full detail later.

The conclusions of your Committee are as follows: The contract made with the Holly Manufacturing Co., of Lockport, N. Y., the builders of the engines, binds them to furnish two sets of pumping machinery, each capable of delivering 12,000,000 galls. of water per day of 24 hours, against a head of 150 ft., the piston speed not exceeding 120 ft. per minute, and to develop a duty of not less than 95,000,000 ft.-lbs. per 100 lbs. of coal burned in the boilers, no allowance for ashes or any other wastes being made. The contractors are also called upon to furnish engines of good design, construction and material.

Your Committee find upon test that the engines furnished by these contractors are of good design, of excellent workmanship, and, as far as they have been able to judge by inspection, of the best material. This Committee are also able to certify that the stipulated capacity has been secured and that the duty actually obtained is considerably above that demanded, exceeding 100,000,000 ft.-lbs. of work done per 100 lbs. of coal consumed. Very respectfully,

R. H. THURSTON,
J. S. COON,
JAS. N. WARRINGTON,
Committee.

Proposals Open.

Artesian Well.—The City Council of Princeton, Ill., will receive bids at once for sinking an artesian well, not less than 5 ins. diam.; bidders to furnish their own specifications. Address the MAYOR OR CITY CLERK.

Sewer.—Terra-cotta sewer, 10-in. diameter. Plans and specifications with L. H. CRAMER, Village Engineer. SAMUEL F. COREY, Village Clerk, Saratoga Springs, N. Y. Nov. 7.

Street Work.—Regulating, grading, macadam paving, curbing, etc. THE COMMISSIONER OF CITY WORKS, 31 Chambers street, New York City. Nov. 9.

Sewers.—Brick and pipe sewers, basins, manholes, flushing tanks, etc. JOHN HUNKELE, Street Commissioner, Newark, N. J. Nov. 9.

Paving Blocks.—Granite paving blocks, 300,000; 3½ to 4 ins. by 6 to 8 ins. by 7½ to 8 ins. E. W. HINCKS, Chairman, Committee on Roads and Bridges, Cambridge, Mass. Nov. 10.

Iron Bridge.—Wrought-iron Pratt truss bridge over the Patapsco river; span about 200 ft. WM. H. SHIPLEY and JOHN W. BOLLMAN, Engineers, 219 East Fayette street, Baltimore, Md. Nov. 12.

Viaduct.—Over railroad tracks at Jackson street. Plans and specifications on file. GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill. Nov. 12.

Roofing and Copper Work.—For Chestnut Hill pumping station. H. T. ROCKWELL, Chairman, Water Board, Boston, Mass. Nov. 14.

Sewers.—Terra-cotta vitrified pipe, 8 and 10 ins. diam.; manholes, basins, flushing tanks, etc. W. J. FLANIGAN, City Clerk, Binghamton, N. Y. Nov. 15.

Bridge.—Across Platte river; built of wood, with pile foundation; 11 spans of 20 ft. each. Plans and specifications on file. CHARLES H. SCOTT: County Clerk, Denver, Col. Nov. 16.

New Croton Aqueduct.—Gatehouse superstructure, roof, floor system and foothridge for the blow-off chamber at Pocantico, on Section No. 4. JAMES C. SPENCER, President, Aqueduct Commissioners, 280 Broadway, New York City. Nov. 16.

Railroad.—Oxford & New Glasgow Ry. in Nova Scotia. Grading, bridge and culvert masonry, fencing, etc. Section 1, Brick Hill Road to Pugwash Junction, 13 miles; Section 2, Pugwash Junction to Pugwash, 5 miles; Section 3, Pugwash Junction to Wallace Station, 7 miles; Wallace Station to Mingo Road, 17 miles. Plans and specifications at the office of the road at Wallace, Cumberland county, N. S., and at the office of the Chief Engineer of Government Railways, Ottawa, A. P. BRADLEY, Secretary, Department of Railways & Canals, Ottawa, P. Q., Canada. Nov. 18.

Drain.—Vitrified, salt-glazed pipe, manhole, etc. THOS. J. LANAHAN, Clerk, Board of Contract, Albany, N. Y. Nov. 21.

Timber.—Sawed yellow pine timber. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. Nov. 22.

Water Works.—At Georgetown, Ky. Franchise and system of works, Population 2,600 and increasing. MOORE & THOMSON, Georgetown, Ky. Nov. 24.

Contracting.

Water-Works.—Proposals will shortly be invited for the construction of the water-works at Pontiac, Mich. The advertisement will appear in the columns of ENGINEERING NEWS. For particulars address JNO. D. NORTON, First National Bank, Pontiac, Mich.

Cast-Iron Water Pipe.—The Board of Public Works, Chicago, Ill., has awarded the contract for 3,250 tons of pipe of various sizes to the McNeal Pipe & Foundry Co., Burlington, N. J., at $28.90 per ton. There were nine bids, ranging from $28.90 to $31.95 per ton; most of them were below $30.95, the figure at which an award was made a few weeks ago. Dennis Long & Co., of Louisville, Ky., bid $28.93 and the Lake Shore Foundry, Cleveland, O., $28.95 per ton.

Wells.—The contract for 3 wells, or less, for the Beach Woods Natural Gas & Oil Co., Jeffersonville, Ind., has been awarded to Fowler & McGillvray at $1,000 for 600 ft. or less, and $1.25 per ft. for additional depth. The Bradford Well Co., of Cincinnati, O., bid for a ⅝-in. bore $1,350 for 600 ft., $1,900 for 1,000 ft. and $2,600 for 1,500 ft. The Louisville Co., of Louisville, Ky., bid about the same as the Bradford Co. S. GOLDBACH, of Jeffersonville, Ind., is Treasurer of the Natural Gas Co.

Pumping Engines.—The following proposals for new pumping engines at Columbus, O., were opened Nov. 1 by the Board of Trustees; A. J. S. Loretz, Brooklyn N. Y.; triple expansion, vertical beam engine with Corliss valve gear, 90,000,000 duty, $59,400; vertical, compound, beam and fly wheel engine with Corliss valve gear, 90,000,000 duty; $73,000.——Holly Manufacturing Co., Lockport, N. Y.; Gaskill vertical compound engine with Corliss valve gear, 100,000,000 duty, $73,500.——Edwin P. Allis & Co., Milwaukee, Wis.; compound, duplex, vertical engine with Corliss valve gear, duty 100,000,000, $75,000.——Robert Wetherill & Co., Chester, Pa.; vertical, compound, crank and fly wheel engine, with Corliss valve gear, 90,000,000 duty, $97,000. The contract was not awarded.

The advertisement for proposals called for a 15,000,000 galls., duplex, compound, condensing engine, of a crank and fly wheel vertical type with Corliss valve gear, and to be so constructed that it can be used as two distinct engines of 7,500,000 galls. capacity each. The engine to be guaranteed to be capable of pumping 15,000,000 U. S. galls. per day against a pressure of 120 lbs. per sq. in. on the pumps, at a piston speed not to exceed 120 ft. per minute, with a boiler pressure of 70 lbs. per sq. in. and to develop a duty of 90,000,000 ft. lbs. per 100 lbs. of coal, based on an evaporation of 10 lbs. of water to 1 lb. of coal fired to the boilers. ROBERT CURTIS is President of the Trustees; DUDLEY A. FILLER, Secretary; A. H. MCALPINE, Superintendent.

Wrought-Iron Pipe for Australia.—The Commissioner of Public Works of Victoria received two bids for 1,650 tons of wrought-iron water-pipe to bring a

supplementary supply from the Watts river to Melbourne. Mephan Ferguson bid £7 10s. per ton, and Johnson & Co. bid £7 9s. 6d. By professional advice the contract was awarded to Mephan Ferguson.

Piles.—The following proposals have been received by the Dock Commissioners, New York City: A. J. Murray, 650 piles 65 to 70 ft. long, $9 each; 90 piles 70 to 75 ft. long, $12 each; 110 piles 40 to 45 ft. long $4 each; Charles B. Carman, $10.40, $13.25, $4.35; Beard & Kempland, $10, $13.50, $4.50. The contract was awarded to A. J. Murray.

Retaining Wall.—At Baltimore, Md., the contract for a retaining wall on the Falls road has been awarded to Tracy & Nardin for $12,680.83. The other bidders were, Conway & Bates, $12,887.64; Wm. Gilmore, $13,470.95; Hollaway & Fox, $14,679.58.

Cross Ties.—Dunn Bros., of Birmingham, Ala., who have a contract for 56 miles of the Warrior Coal Fields R. R., have let the contract for ties to G. H. Howell, of Birmingham.—W. H. Veale, of St. Augustine, Fla., has the contract for ties on the extension of the Orange Belt R. R. from Tarpon Spring to Petersburg, 7 miles.

Macadamizing Stone.—The following bids for 400 toises (about 3,767 cu. yds.) of macadamizing stone, have been received by the Harbor Commissioners, Montreal, Canada: McKenna & Bastien, $12.50 per toise; Robert Parker, $12.74; John Murray, $12.97; John Parker, $13; Provost Benoit, $14.70; James Cochrane, $15.22; Boismenu & Rheaume, $16.25.

Water Works Franchise.—The following proposals for the water-works franchise were opened Oct. 25 at Manitowoc, Wis.: Moffett, Hodgkins & Clarke, Watertown, N. Y., annual rental $6,500; hydrants on extensions, $40; C. E. Gray, Jr., & Co., Chicago, $6,750, $45; W. H. Fritchmann & Co., Chicago, $6,900, $42; American Water Works & Guarantee Co., Pittsburg, Pa., $8100, $40. EMIL BAEUSCH is City Clerk.

Water Pipe.—At Lake, Ill., the Board of Trustees have awarded the contract for about 27,000 ft. of 24-in. water pipe to Shickle, Harrison & Howard, of St. Louis, Mo., at $29.74 per ton of 2,000 lbs. The contract will amount to about $95,000.

Grading.—The only bid received by J. W. MCDONALD, Superintendent of Streets, Boston, Mass., for grading Beacon street was from the Boston & Albany R. R. Co., at 52 cts. per cu. yd.

Granite Paving and Grout.—With regard to the contract awarded last week at Portland, Me., Mr. H. G. BRIGGS, Chairman of the Street Committee, writes us as follows:

PORTLAND, Me., Oct. 31, 1887.

EDITOR ENGINEERING NEWS:

Yours received this morning, and I take great pleasure in giving you the information sought for. By way of preface, I would say that the city of Portland advertises a little differently for its blocks than any other city I know of. We advertise for paving by the yard, and the paving contractor is paid by the yard according to the measurements made by the City Civil Engineer, after the blocks are laid. The Street Department lays the blocks. We never put down pavement in this city by contract; the quarryman is the only contractor. The block we use here is that technically known as the New York block; it averages 36 to the yard. During this last year we have laid about 17,000 sq. yds., and paid the contractor $1.10 per yd. as laid, so you see we have paid about 4 cts. apiece for blocks. Next year we shall have to pay $1.22 per yd. The bidders on our contract were E. B. Mallet, Jr., of Freeport, Me., $1.22; Maine & New Hampshire Granite Co., $1.24; Andrew & Son, of Biddeford, $1.50, and the Bodwell Granite Co., $1.92. You see there is a very wide variation in these figures; why the Bodwell Granite Co. bid so high I cannot say; they have for several years furnished us with blocks at $1.25, and last year bid $1.25 but did not get the contract. In relation to the "granite grout," would say we awarded the contract to E. B. Mallet, Jr., at the rate of $1.12½ per ton, the size of the grout to be suited to a Blake crusher. The city yards are located adjacent to the tracks of the Portland & Rochester R. R., and the above prices are for blocks and grout on cars at the siding by the city yard. The city of Portland does not lay its blocks by contract, the only contract we make is that made with the quarryman to furnish us the blocks. The Street Commissioner has full charge of laying the blocks, and it is done by our own gang, by the day. We have laid this last year about 17,000 sq. yds. of paving blocks at an average cost of $1.65 per yd., a price which I think is unequalled by any other city in the country. Yours,

H. G. BRIGGS.

Trenching, Sewer and Boilers.—At Lancaster, Pa., the following bids were received Oct. 28, by WM. A. MONTON, Mayor, for trenching for the water mains: Kitch & Smith, Lancaster, 46 cts. per cu. yd.; Bernard C. Malone, Lancaster, 50 cts.; F. H. Hunter, Lancaster, 69 cts.; Everson & Christy, Akron, O., 75 cts.; D. & C. W. Schubel, $1. The contract was awarded to Kitch & Smith.—The following were the bids for the 6 ft. brick sewer: Bernard C. Malone, $7 per lin. ft.; Everson & Christy, $7.50; Kitch & Smith, $7.24 and $6.95. The contract was awarded to B. C. Malone.—The following were the bids for the four 100 H. P. steel boilers: John Wood, Conshohocken, $6,390; A. C. Welchans, Lancaster, $6,481; Harrisburg Car Co., $6,725; Babcock & Wilcox Co., Philadelphia, $7,986.30; F. M. Marion, Lancaster, $8,000; Farquhar & Sons, York, Pa., $9,350; John Best, Lancaster, $8,400; Shay & Berry, Milton, Pa., $8,800; W. H. Green, Chester, Pa., $9,500. The contract was awarded to the Babcock & Wilcox Co.

The Wainwright Manufacturing Co., of Boston, at a meeting held on Oct. 26, elected the following officers: JERE. ABBOTT, President; JOHN A. LORING, Vice President: PERCIVAL L. EVERETT, Treasurer; C. D WAINWRIGHT, Genl. Manager: JAMES M. BETTON, Secretary; Directors: JERE. ABBOTT, JOHN A. LORING, PERCIVALL. EVERETT, CHAS. S. 'ANA, GIDEON S ULL WM. B. BACON and C. D. WAINWRIGHT. The company is reported as doing a good business, and as having a long list of unfilled orders on hand. Among late sales of their Feed-Water Heaters during the month of October are the following:—two in Boston, and one each in the following places:—Somerville and No. Billerica, Mass; Freeport, Presque Isle and Cumberland Mills, Me: Montpelier and Burlington, Vt.: Phi lipsburg and Dublin, Pa: Davenport, Iowa; Augusta, G a; Yarmouthville, Nova Scotia; Montreal, P. Q., and Yokohama, Japan. They have recently issued a supplement to their catalogue of Jan. 1887, containing a list of firms using these heaters, with testimonials of same.

City Work.—At Omaha, Neb., the following were the proposals received for sewer in District 63:

	Hugh Murphy.	J. J. Johnson & Co.	J. O. Corby.	John Thompson.	John F. Daley.
6-in. laterals	0.65	0.50	—	0.70	—
4-in. "	0.60	0.46	—	0.58	—
24 in. sewer pipe	3.24	3.29	3.90	2.95	3.20
18-in. " "	1.89	2.01	1.75	1.70	2.00
15-in. " "	1.54	1.44	1.40	1.40	1.75
8-in. " "	1.09	1.56	1.18	1.20	1.05
12 in. catch-basins, per lin ft.	.75	1.35	0.70	0.90	0.70
Manholes, per lin. ft.	3.50	4.00	4.00	3.50	4.50
Catch-basins, plan A and B	5.00	4.00	3.50	3.75	4.25

The contract was awarded to John Thompson. The city has expended $350,000 for paving streets, $280,000 for sewerage; $60,000 for curbing; $10,000 for guttering; $95,000 for grading, and $140,000 for viaducts. Other improvements are still in progress.

Sewers.—*Brooklyn, N. Y.*—The following proposals were opened Oct. 28: D. J. Crean; 12, 15, 18 and 30-in. cement pipe, $1.03, $1.50, $1.60, $5.50 per ft.; manholes, $40 each; street basins, $110 each; Wm. Weis, $1.08 $1.50, $1.85 and $4.50, $36, $95; John S. Bogert, $1, $1.35, $1.50 and $4.50, $36, $100; J. P. Crawford, $1, $1 28, $1.55 and $4 $34, $98.

Toronto, Canada.—The contract for the Garrison Creek sewer has been awarded to Murray & McFarlane at $28,421. The work consists of 1,025 lin. yds. of 5 ft. 6 ins. circular sewer, 9 ins. thick, average depth, 12 ft. 6 ins. 3 bellmouths, 10 manholes, 10 culverts, 50 lin. yds. of 30 in. circular sewer. The engineer's estimate was $34,461.

Providence, R. I.—Contracts for sewer work on three streets were awarded Oct. 27 by the Board of Public Works, to John Keogh, of Providence, at the following prices: laying 12-in. pipe sewer, $1.18, 1.20, $1.25 per lin. ft.: setting 6-in. house connections, 10 cts. each; manholes, $18 each.

Harrisburg, Pa.—A sewer contract has been awarded by the Highway Committee to James Nolan, at $999.

Street Work.—*Buffalo N. Y.*—The lowest bidder for repaving Union street with first quality Medina sandstone, was John Miller, $5,795.

Newark, N. J.—The contract for paving Wickliffe street has been awarded to B. M. & J. F. Shanley, at $2.29 per sq. yd. for about 3,600 sq. yds. of trap blocks. James Conway bid $2.37½ and Thomas O'Connor, $2.38. The contract for flagging stone has been awarded to Thomas O'Connor at 14½ cts. per sq. ft. ERNEST ADAM, City Surveyor.

Washington, D. C.—The work of improving North Capitol street, between I and K streets, has been let by WM. LUDLOW, Engineer Commissioner, at the following prices: removing old curb, 8 cts. per lin. ft.; removing old cobble, flagging, etc., 15 cts. per sq. yd.; grading, 25 cts. per cu. yd.; setting and resetting curb, 18 and 12 cts. per lin. ft.; setting special granite curb, 40 cts. per lin. ft.; constructing combination curb and gutter, $1.27 per lin. ft.; laying brick sidewalk, 28 cts. per sq. yd.; laying coal tar distillate and asphalt pavement, $1.98 per sq. yd.

Chattanooga, Tenn.—The following proposals for sidewalk construction have been received by the Board of Public Works: Chattanooga River Brick Co., 5 and 6-in. curbing, 37½ and 40 cts. per lin. ft.; laying brick pavement, 50 cts. per sq. yd.; excavation and filling where depth exceeds 6 ins., 25 cts. per cu. yd.; J. F. Wright, 42 and 45 cts., 50 cts., 36 cts.; A. H. Gibbs, 45 and 50 cts., no bid, 25 and 30 cts. The following proposals were for work on Market street: Venable Bros. & Foster, paving, $2.25 per sq. yd.; granite curbing, 21 and 24 ins. deep, 75 and 80 cts. per lin. ft.; Southern Granite Co., $2.14, 89 and 94 cts. The city will advertise for 11,000 sq. yds of granite paving.

Birmingham, Ala.—The following proposals for 20,000 sq. ft. of sidewalk flagging have been received by J. R CARTER, City Engineer: Daniel Barry, 32½ cts. per sq. ft.; Chas. A. Shook, 34½ cts.; R. O. Aikens, 38½ cts.; White & Co., 45 cts.; R. N. Lee, 50 cts.; Larney Bros., 52 cts; Flanegan & Co., 55 cts. The contract was awarded to Daniel Barry, who freights the stone 23 miles. The sidewalks are 12 or 15 ft. wide; the specifications allow 2 and 3 stones across; stones not less than 18 ins. broad and 5 ins. thick.

Cincinnati, O.—Only one bid was received for improving Cypress street; the contract was awarded to Lewis Grower at $1,500.

Indianapolis, Ind.—The following proposals have been received by S. H. SHEARER, City Engineer, for curbing and Medina sandstone paving: Walter S. Biglow, Buffalo, N. Y., $26.46 per lin. ft. front on each side; T. B. Naughton, Buffalo, N. Y., $24.25, curb, 88 cts.; Claflen Paving Co., Cleveland, O., $23,63; curb, 85 cts.; Wm. F. Shanks, Louisville, Ky., $25.40; curb, 85 cts.

Leavenworth, Kan.—Contracts for sidewalks have been awarded as follows: James Armstrong, 30, 34 and 50 cts. per lin. ft.; B. G. Thompson, 30 and 38 cts.; Thomas Kneaves, 28, 29, 29½ and 45 cts. Grading contracts were awarded to D. W. Davis, 16½ cts. per cu. yd. and 80 cts. for pipe; Pat. Keating, 25¾ cts.; A. L. West, 18 cts.; Pat. O'Brien, 30 cts. Paving contracts were awarded to S. S. Dutwiler & Co., $2.40 per sq. yd.; J. J. Armstrong, $2.40; A. Jaicks, $2 30.

St. Paul, Minn.—The Board of Public Works has awarded grading contracts to Wm. A. Davern, $15,250; $7,425; McArthur Bros., $3,000; James Forrestal, $5,400.

Toronto, Canada.—Contracts have been awarded as follows: Geo. Trimble, cedar block pavement, 70 cts. per sq. yd.; curbing, 18 cts. per lin. ft.; crossing plates, $2 50 per 100 lbs.; Wm. Jones, 74 and 77 cts., 18 cts., $2.50 and $2.75; D. Van Vlack, 60 cts., 16 cts. E. H. Farquhar, 80 cts., 18 cts., 25 cts.; stone sets, $2.25 per sq. yd. A. W. Godson, 70 cts., 17 cts., $2.50; cobble stones and stone sets, $1.10 per sq. yd.; cobble pavement, 80 cts. per sq. yd. A. W. Godson, grading and macadam, $1.49 per sq. yd.; stone curbing, 85 cts. per lin. ft.; stone water channels, 43 cts. per lin. ft.; stone street crossings, $3 per sq. yd. A. J. Brown, curbing, 20 cts. per lin. ft.; macadam, 25 cts. per sq. yd.; water channels, $1.28 per lin. ft.; cobble stone pavement, 80 cts. per sq. yd.; crossing plates, $2.50 per 100 lbs.; fencing, 28 cts. per lin. ft.; culverts, $25 per 1000 ft. B. M. A. W. Godson, 6-ft. flag sidewalk, $2.45 per lin. ft.; turfing boulevards, 9 cts. per sq. yd. A. J. Brown, flag sidewalks, $4.30 per lin. ft.; stone curbing, 90 cts. per lin ft.; resetting curb, 50 cts.

Harrisburg, Pa.—The contract for grading Cameron street has been awarded by the Highway Committee to J. F. Schlayer at $1,550.

RAILROADS.

East of Chicago.

Existing Roads.—*Pennsylvania.*—About the most exciting announcement that Wall street has been greeted with this week, is the raising of the Pennsylvania's dividend from 2½ to 3 per cent. It would seem that the importunity of the foreign stockholders has at last been of some avail. It is certain at least that it has been a most excellent bull point for the stock market, and has strengthened it very perceptibly.

Chicago, Kalamazoo & Saginaw.—The 31 miles section between Kalamazoo and Hastings, Mich., has been opened for business. The directors have voted to proceed at once with the survey of the division between Hastings and Saginaw, 91 miles.

Boston & Maine.—A recent rumor states that in case the company fails to secure the Boston, Concord & Montreal road, they will obtain control of the Portland & Ogdensburg and extend it from Fabyan's to Scott's in Lancaster, to connect with the Upper Coos railroad. They would thus have a connection with the Canadian Pacific system, which is one of the points that the managers of the Boston & Maine are anxious to make. It was probably in furtherance of this plan that the bill was introduced in the New Hampshire Senate authorizing the Boston & Maine to purchase the franchise of the Eastern.—On the Central Massachusetts road the track is laid to the Connecticut River bridge. It is stated that work will begin on the Holyoke branch as soon as the Northampton line is completed.

Cincinnati, Hamilton & Dayton.—JULIUS DEXTER has been elected President in the place of A. S. WINSLOW, resigned. This action by the directors indicates that they are confident that the pending suit for the appointment of a receiver will be defeated.

New Projects and Surveys.—*Seymour & Southwestern.*—This Indiana company proposes to build from Seymour to Orleans or Paoli, about 40 miles. F. M. SWOPE, of Seymour, is President.

Atlantic & Mississippi.—This proposed line from Cleveland to St. Louis is being advocated by J. H. CABLE, of Lafayette, Ind., who is endeavoring to secure subsidies from the towns along the proposed route.

vote on the appropriation of $5,000 for an artesian well was 522 for and 82 against the appropriation.——Jacksonville. Steps will be taken to ensure a better water supply.——Paxton. The new works are progressing. The water will be pumped to a tank 20 ft. high, standing on a brick tower 80 ft. high. The mains are being laid. ——Lewistown. The Lewistown Water Co., has been incorporated by LEWIS W. ROSS, A. M. BARRETT, and others, with a capital stock of $25,000.——Bloomington. An additional supply of water from 7 tube wells, 8-ins' diameter and 60 ft. deep, has been added to the water system.

Iowa.—Knoxville. The city is putting in a new system of water-works.

Wisconsin.—Hayward. Water-works are under construction and will cost from $15,000 to $20,000. As the place is not incorporated as a village, all Sawyer county will be taxed for the cost of the works.

California.—San Diego. W. S. HOWLAND has contracted to sink an artesian well on Coronado beach, for the Coronado Beach Co., and give a supply of 2,000,000 galls. per day. The company will pay $30,000 if he strikes water, gas or oil in 3,000 ft.——Hayward. Two large wells are being dug and the water will be pumped through 5,000 ft. of 5-in. pipe to reservoirs on the hills. WM. HAYWARD and WM. KNOX are each putting in a well and a reservoir.

Texas.—Brownwood. The water-works were tested Oct. 25 with satisfactory results. With a pressure of 130 lbs. a stream was thrown over the court-house.—— Fort Worth. The Galveston *News* says the financial condition of the water-works is bad and that there is a disposition to lease them to a responsible party who will successfully operate them.

Nashville, Tenn.—Work is progressing rapidly on the new water-works. The filter on the island, which has been under construction for 2 years, is now finished. The masonry of the wells and engine house is being built, and is now far enough advanced to be safe from interference by the river. A 36-in. main laid on the river bed leads the water from the filter to the pump well, the bottom of which is 16 ft. below the bottom of the river. The masonry and buildings are expected to be completed, and the erection of the pumping machinery commenced in November. The pumping plant will consist of Gaskill engines, furnished by the Holly Manufacturing Co., of Lockport, N. Y. Work is also in progress on the reservoir. Whitsett & Adams are the contractors for the filter and reservoir; Hicks, Holmes & Co., of Nashville, Tenn., are the contractors for the masonry. Mr. ED. MEAD, formerly city engineer, is in charge of the work.

Report of the Water Commissioners of Cobleskill, N. Y.—The Board of Water Commissioners of the village of Cobleskill, N. Y., have issued their first annual report, dated August 1, 1887. The Board was organized June 15, 1886, its members being the same as the Board of Trustees of the village. In July, 1886, Mr. WM. N. ROBERTS was engaged as Chief Engineer and he remained in charge until the works were practically completed in July of the present year. In answer to the advertisements, seven proposals were received for the construction of the works, and the contract was awarded to Stanton & Doyle, of Cohoes, N. Y. The contract for the cast-iron pipe was awarded to the Warren Foundry & Machine Co., Phillipsburg, N. J., being the lowest of the four bidders. The Mathews hydrants and Eddy valves were adopted. The distribution system comprises 6,539 ft. of 4-in. pipe, 4,530 ft. of 6-in., 2,872 ft. of 8-in., 11,162 ft. of 10-in., 2,110 ft. of 12-in., 187 ft. of 16-in. and 109 ft. of 20-in.; aggregating about 5¼ miles of mains, on which are placed 44 hydrants. The engineer's report is appended. MARTIN D. BORST is President of the Board, and GEO. D. HARDER, Secretary.

Galveston, Tex.—The City Council has accepted the proposition of Mr. MORGAN JONES to lease the water-works to the city for another year; his terms are $585 per month. For operating the water-works the following bids were received: C. E. Johnson, 1st, without revenue from private consumers, $600 per month; 2nd, with private supply cut off, $422; 3rd, receiving revenue from private supply, $415. Jos. Duddy and C. F. Ruhl, 1st, without revenue from private consumers, $545; 2nd, with revenue, $445; 3rd, city to furnish fuel, fireman and repairs, $180. Contract made with C. E. Johnson for $415 per month.

Mr. J. D. COOK, of Toledo, O., who was offered the position of Chief Engineer for the proposed new water-works, has accepted the appointment and will be in Galveston this month. It is intended to issue the advertisements for proposals and let the contracts by January. Mr. COOK reported upon the new works, to be built with the $450,000 made available under the new charter, when the city first determined upon a supply of which the present salt water system was intended merely as a forerunner. The new supply will be from artesian wells.

Nebraska City, Neb.—On Nov. 3rd the city celebrated the completion of the system of water-works (which was officially tested that day), the laying of the corner stone of the west abutment of the great bridge for the Chicago, Burlington & Quincy R. R., to be built across the Missouri, and the recent acquisition of the Missouri Pacific R. R. The order of the exercises was a procession from the City Hall to the site of the bridge, the laying of the corner stone, an address by Hon. J. STERLING MORTON, procession to the City Hall, dinner, official test of the water-works, and a ball in the evening. N. B. LARSH is Mayor.

Machias, Me.—Referring to the new water-works which were mentioned on p. 302, Mr. ROSE writes as follows:

70 Devolshire Street,
BOSTON, MASS., Oct. 31, 1887

EDITOR ENGINEERING NEWS:

Your blank for Statistics of New Water-Works Construction, addressed to me at Machias, Me., is at hand. There has nothing been done about water-works at Machias, except preliminary survey and estimate made by me the last of Sept., 1887. It is rather probable that they may, at an early day, organize a company and proceed with the work. They have a grand opportunity for utilizing a natural supply from springs, 105 ft. above the level of streets at Court House and 125 ft. above streets at Custom House, by simply building reservoir and piping. Will retain your blank, and if I do anything further with the project, will give you such information as I may be able to.

Smith's Falls, Ont.—During has grown considerably in impo have been spent in buildings this amount about $100,000 have Canadian Pacific Ry. in the er roundhouse and in other impro of the Montreal Air Line, t quarters of which are now occ railway company has introduc works and three hydrants are t iron bridge being built by the G completed and the incandesce lighting will be in operation $7,000 have been spent on str wells, etc. A very large numb erected, and many more are t Among other improvements a are the extension of the railr erection of a hotel by J. M. McI $10,000.

The New Pumping Engine following is the report on the n

CHI

HON. GEO. B. SWIFT,
Com. of Public Works, Chi

SIR:—The undersigned, the C you to make a trial of the new G now in operation at the North beg leave to submit the followin obtained.

A trial of each set of machine on Monday, the 24th inst., with t the trials being of 24 hours dur having been adjudged, by the C settle the questions referred to mentary trial was also made of to determine the efficiency of t tribution of heat in the engin and the calculated results, will tail later.

The conclusions of your Com The contract made with the Ho of Lockport, N. Y., the builders them to furnish two sets of pumping machinery, each capable of delivering 12,000,000 galls. of water per day of 24 hours, against a head of 150 ft., the piston speed not exceeding 120 ft. per minute, and to develop a duty of not less than 95,000,000 ft.-lbs. per 100 lbs. of coal burned in the boilers, no allowance for ashes or any other wastes being made. The contractors are also called upon to furnish engines of good design, construction and material.

Your Committee find upon test that the engines furnished by these contractors are of good design, of excellent workmanship, and, as far as they have been able to judge by inspection, of the best material. This Committee are also able to certify that the stipulated capacity has been secured and that the duty actually obtained is considerably above that demanded, exceeding 100,000,000 ft.-lbs. of work done per 100 lbs. of coal consumed. Very respectfully,

R. H. THURSTON,
J. S. COON,
JAS. N. WARRINGTON,
Committee.

Proposals Open.

Artesian Well.—The City Council of Princeton, Ill., will receive bids at once for sinking an artesian well, not less than 5 ins. diam.: bidders to furnish their own specifications. Address the MAYOR OR CITY CLERK.

Sewer.—Terra-cotta sewer, 10-in. diameter. Plans and specifications with L. H. CRAMER, Village Engineer. SAMUEL F. COREY, Village Clerk, Saratoga Springs, N. Y. Nov. 7.

Street Work.—Regulating, grading, macadam paving, curbing, etc. THE COMMISSIONER OF CITY WORKS, 31 Chambers street, New York City. Nov. 9.

Sewers.—Brick and pipe sewers, basins, manholes, flushing tanks, etc. JOHN HUNKELE, Street Commissioner, Newark, N. J. Nov. 9.

Paving Blocks.—Granite paving blocks, 300,000; 3½ to 4 ins. by 6 to 8 ins. by 7½ to 8 ins. E. W. HINCKS, Chairman, Committee on Roads and Bridges, Cambridge, Mass. Nov. 10.

Iron Bridge.—Wrought-iron Pratt truss bridge over the Patapsco river; span about 200 ft. WM. H. SHIPLEY and JOHN W. BOLLMAN, Engineers, 219 East Fayette street, Baltimore, Md. Nov. 12.

Viaduct.—Over railroad tracks at Jackson street. Plans and specifications on file. GEO. B. SWIFT, Commissioner of Public Works, Chicago, Ill. Nov. 12.

Roofing and Copper Work.—For Chestnut Hill pumping station. H. T. ROCKWELL, Chairman, Water Board, Boston, Mass. Nov. 14.

Sewers.—Terra-cotta vitrified pipe, 8 and 10 ins. diam.; manholes, basins, flushing tanks, etc. W. J. FLANIGAN, City Clerk, Binghamton, N. Y. Nov. 15.

Bridge.—Across Platte river; built of wood, with pile foundation; 11 spans of 20 ft. each. Plans and specifications on file. CHARLES H. SCOTT; County Clerk, Denver, Col. Nov. 16.

New Croton Aqueduct.—Gatehouse superstructure, roof, floor system and footbridge for the blow-off chamber at Pocantico, on Section No. 4. JAMES C. SPENCER, President, Aqueduct Commissioners, 280 Broadway, New York City. Nov. 16.

Railroad.—Oxford & New Glasgow Ry. in Nova Scotia. Grading, bridge and culvert masonry, fencing, etc. Section 1, Brick Hill Road to Pugwash Junction,

$1,850 for 600 ft., $1,000 for 1,000 ft. and $3,000 for 1,800 ft. The Louisville Co., of Louisville, Ky., bid about the same as the Bradford Co. S. GOLDBACH, of Jeffersonville, Ind., is Treasurer of the Natural Gas Co.

Pumping Engines.—The following proposals for new pumping engines at Columbus, O., were opened Nov. 1 by the Board of Trustees; A. J. S. Loretz, Brooklyn N. Y.; triple expansion, vertical beam engine with Corliss valve gear, 20,000,000 duty, $59,400; vertical, compound, beam and fly wheel engine with Corliss valve gear, 90,000,000 duty; $73,000.——Holly Manufacturing Co., Lockport, N. Y.; Gaskill vertical compound engine with Corliss valve gear, 100,000,000 duty, $73,500.—— Edwin P. Allis & Co., Milwaukee, Wis.; compound, duplex, vertical engine with Corliss valve gear, duty 100,000,000, $75,000.——Robert Wetherill & Co., Chester, Pa.; vertical, compound, crank and fly wheel engine, with Corliss valve gear, 90,000,000 duty, $97,000. The contract was not awarded.

The advertisement for proposals called for a 15,000,000 galls., duplex, compound, condensing engine, of a crank and fly wheel vertical type with Corliss valve gear, and to be so constructed that it can be used as two distinct engines of 7,500,000 galls. capacity each. The engine to be guaranteed to be capable of pumping 15,000,000 U. S. galls. per day against a pressure of 120 lbs. per sq. in. on the pumps, at a piston speed not to exceed 120 ft. per minute, with a boiler pressure of 70 lbs. per sq. in. and to develop a duty of 90,000,000 ft. lbs. per 100 lbs. of coal, based on an evaporation of 10 lbs. of water to 1 lb. of coal fired to the boilers. ROBERT CURTIS is President of the Trustees; DUDLEY A. FILLER, Secretary; A. H. MCALPINE, Superintendent.

Wrought-Iron Pipe for Australia.—The Commissioner of Public Works of Victoria received two bids for 1,850 tons of wrought-iron water-pipe to bring a

supplementary supply from the Watts river to Melbourne. Mephan Ferguson bid £7 10s. per ton, and Johnson & Co. bid £7 9s. 6d. By professional advice the contract was awarded to Mephan Ferguson.

Piles.—The following proposals have been received by the Dock Commissioners, New York City: A. J. Murray, 850 piles 65 to 70 ft. long, $9 each; 90 piles 70 to 75 ft. long, $12 each; 110 piles 40 to 45 ft. long $4 each; Charles B. Carman, $10.40, $13.25, $4 25; Beard & Kempland, $10, $13.50, $4.50. The contract was awarded to A. J. Murray.

Retaining Wall.—At Baltimore, Md., the contract for a retaining wall on the Falls road has been awarded to Tracy & Nardin for $12,680.83. The other bidders were, Conway & Bates, $12,867.64; Wm. Gilmore, $13,470.95; Hollaway & Fox, $14,679.58.

Cross Ties.—Dunn Bros., of Birmingham, Ala., who have a contract for 56 miles of the Warrior Coal Fields R. R., have let the contract for ties to G. H. Howell, of Birmingham.—W. H. Veale, of St. Augustine, Fla., has the contract for ties on the extension of the Orange Belt R. R. from Tarpon Spring to Petersburg, 7 miles.

Macadamizing Stone.—The following bids for 400 toises (about 3,767 cu. yds.) of macadamizing stone, have been received by the Harbor Commissioners, Montreal.

	Hugh Murphy.	J. J. Johnson & Co.	J. O. Corby.	John Thompson.	John F. Daley.
.....	0.65	0.50	—	0.70	—
.....	0.60	0.46	—	0.58	—
.....	3.24	3.29	3.90	2.95	3.20
.....	1.89	2.01	1.75	1.70	2.00
.....	1.54	1.44	1.40	1.40	1.75
.....	1.09	1.56	1.18	1.20	1.05
er lin ft.	.75	1.35	0.70	0.90	0.70
.....	3.50	4.00	4.00	3.50	4.50
and B...	5.00	4.00	3.50	3.75	4.25

warded to John Thompson. The 0,000 for paving streets, $280,000 for curbing; $10,000 for guttering; and $140,000 for viaducts. Other ill in progress.

N. Y.—The following proposals D. J. Crean; 12, 15, 18 and 30-in. 1.50, $1.60, $5.50 per ft.; manholes, s, $110 each; Wm. Weis, $1.08 $1.50. ; John S. Bogert, $1, $1.35, $1.50 and Crawford, $1, $1 28, $1.55 and $1

e contract for the Garrison Creek rded to Murray & McFarlane at sists of 1,025 lin. yds. of 5 ft. 6 ins thick, average depth, 12 ft. 6 ins. holes, 10 culverts, 50 lin. yds. of The engineer's estimate was

ntracts for sewer work on three l Oct. 27 by the Board of Public h, of Providence, at the following ipe sewer, $1.18, 1.20, $1.25 per lin. se connections, 10 cts. each; manholes, $25 each.

Harrisburg, Pa.—A sewer contract has been awarded by the Highway Committee to James Nolan, at $999.

Street Work.—*Buffalo N. Y.*—The lowest bidder for repaving Union street with first quality Medina sandstone, was John Miller, $5,795.

Newark, N. J.—The contract for paving Wickliffe street has been awarded to B. M. & J. F. Shanley, at $2.29 per sq. yd. for about 3,600 sq. yds. of trap blocks. James Conway bid $2.37½ and Thomas O'Connor, $2.38. The contract for flagging stone has been awarded to Thomas O'Connor at 14½ cts. per sq. ft. ERNEST ADAM, City Surveyor.

Washington, D. C.—The work of improving North Capitol street, between I and K streets, has been let by WM. LUDLOW, Engineer Commissioner, at the following prices: removing old curb, 8 cts. per lin. ft.; removing old cobble, flagging, etc., 15 cts. per sq. yd.; grading, 25 cts. per cu. yd.; setting and resetting curb, 18 and 12 cts. per lin. ft.; setting special granite curb, 40 cts. per lin. ft.; constructing combination curb and gutter, $1.27 per lin. ft.; laying brick sidewalk, 28 cts. per sq. yd.; laying coal tar distillate and asphalt pavement, $1.98 per sq. yd.

Chattanooga, Tenn.—The following proposals for sidewalk construction have been received by the Board of Public Works: Chattanooga River Brick Co., 5 and 6-in. curbing, 37½ and 40 cts. per lin. ft.; laying brick pavement, 50 cts. per sq. yd.; excavation and filling where depth exceeds 6 ins., 25 cts. per cu. yd.; J. F. Wright, 42 and 45 cts., 50 cts., 35 cts.; A. H. Gibbs, 45 and 50 cts., no bid, 25 and 30 cts. The following proposals were for work on Market street: Venable Bros. & Foster, paving, $2.25 per sq. yd.; granite curbing, 21 and 24 ins. deep, 75 and 80 cts. per lin. ft.; Southern Granite Co., $2.14, 89 and 94 cts. The city will advertise for 11,000 sq. yds of granite paving.

Birmingham, Ala.—The following proposals for 20,000 sq. ft. of sidewalk flagging have been received by J. R CARTER, City Engineer: Daniel Barry, 32½ cts. per sq. ft.; Chas. A. Shook, 34½ cts.; B. O. Aikens, 38½ cts.; White & Co., 45 cts.; R. N. Lee, 50 cts.; Larney Bros., 52 cts; Flanegan & Co., 55 cts. The contract was awarded to Daniel Barry, who freights the stone 23 miles. The sidewalks are 12 or 15 ft. wide; the specifications allow 2 and 3 stones across: stones not less than 18 ins. broad and 5 ins. thick.

Cincinnati, O.—Only one bid was received for improving Cypress street; the contract was awarded to Lewis Grower at $1,500.

Indianapolis, Ind.—The following proposals have been received by S. H. SHEARER, City Engineer, for curbing and Medina sandstone paving: Walter S. Biglow, Buffalo, N. Y., $26.46 per lin. ft. front on each side; T. B. Naughton, Buffalo, N. Y., $24.25, curb, 88 cts.; Claflen Paving Co., Cleveland, O., $23.63; curb, 85 cts.; Wm. F. Shanks, Louisville, Ky., $25.40; curb, 85 cts.

Leavenworth, Kan.—Contracts for sidewalks have been awarded as follows: James Armstrong, 30, 34 and 50 cts. per lin. ft.; B. G. Thompson, 30 and 38 cts.; Thomas Kneaves, 28, 29, 29½ and 45 cts. Grading contracts were awarded to D. W. Davis, 16½ cts. per cu. yd. and 80 cts. for pipe; Pat. Keating, 25¾ cts.; A. L. West, 18 cts.; Pat. O'Brien, 30 cts. Paving contracts were awarded to S. S. Dotwiler & Co., $2.40 per sq. yd.; J. J. Armstrong, $2.40; A. Jaicks, $2 30.

St. Paul, Minn.—The Board of Public Works has awarded grading contracts to Wm. A. Davern, $15,250· $7,425; McArthur Bros., $3,000; James Forrestal, $5,400.

Toronto, Canada.—Contracts have been awarded as follows: Geo. Trimble, cedar block pavement, 70 cts. per sq. yd.; curbing, 18 cts. per lin. ft.; crossing plates, $2 50 per 100 lbs.; Wm. Jones, 74 and 77 cts., 18 cts., $2.50 and $2.75; D. Van Vlack, 60 cts., 16 cts. E. H. Farquhar, 80 cts., 18 cts., 25 cts.; stone sets, $2.25 per sq. yd. A. W. Godson, 70 cts., 17 cts., $2.50; cobble stones and stone sets, $1.10 per sq. yd.; cobble pavement, 80 cts. per sq. yd. A. W. Godson, grading and macadam, $1.49 per sq. yd.; stone curbing, 85 cts. per lin. ft.; stone water channels, 43 cts. per lin. ft.; stone street crossings, $3 per sq. yd. A. J. Brown, curbing, 20 cts. per lin. ft.; macadam, 25 cts. per sq. yd.; water channels, $1.28 per lin. ft.; cobble stone pavement, 80 cts. per sq. yd.; crossing plates, $2.50 per 100 lbs.; fencing, 28 cts. per lin. ft.; culverts, $25 per 1000 ft. B. M. A. W. Godson, 6-ft. flag sidewalk, $2.45 per lin. ft.; turfing boulevards, 9 cts. per sq. yd. A. J. Brown, flag sidewalks, $4.30 per lin. ft.; stone curbing, 90 cts. per lin ft.; resetting curb, 50 cts.

Harrisburg, Pa.—The contract for grading Cameron street has been awarded by the Highway Committee to J. F. Schlayer at $1,550.

RAILROADS.

East of Chicago.

Existing Roads.—*Pennsylvania.*—About the most exciting announcement that Wall street has been greeted with this week, is the raising of the Pennsylvania's dividend from 2½ to 3 per cent. It would seem that the importunity of the foreign stockholders has at last been of some avail. It is certain at least that it has been a most excellent bull point for the stock market, and has strengthened it very perceptibly.

Chicago, Kalamazoo & Saginaw.—The 31 miles section between Kalamazoo and Hastings, Mich., has been opened for business. The directors have voted to proceed at once with the survey of the division between Hastings and Saginaw, 91 miles.

Boston & Maine.—A recent rumor states that in case the company fails to secure the Boston, Concord & Montreal road, they will obtain control of the Portland & Ogdensburg and extend it from Fabyan's to Scott's in Lancaster, to connect with the Upper Coos railroad. They would thus have a connection with the Canadian Pacific system, which is one of the points that the managers of the Boston & Maine are anxious to make. It was probably in furtherance of this plan that the bill was introduced in the New Hampshire Senate authorizing the Boston & Maine to purchase the franchise of the Eastern.—On the Central Massachusetts road the track is laid to the Connecticut River bridge. It is stated that work will begin on the Holyoke branch as soon as the Northampton line is completed.

Cincinnati, Hamilton & Dayton.—JULIUS DEXTER has been elected President in the place of A. S. WINSLOW, resigned. This action by the directors indicates that they are confident that the pending suit for the appointment of a receiver will be defeated.

New Projects and Surveys.—*Seymour & Southwestern.*—This Indiana company proposes to build from Seymour to Orleans or Paoli, about 40 miles. F. M. SWOPE, of Seymour, is President.

Atlantic & Mississippi.—This proposed line from Cleveland to St. Louis is being advocated by J. H. CABLE, of Lafayette, Ind., who is endeavoring to secure subsidies from the towns along the proposed route.

Southern.

Existing Roads.—*Memphis & Charleston.*—The minority stockholders of this company have obtained an injunction to prevent the East Tennessee, Virginia & Georgia Company from voting the stock held by it in the coming election. The application for the injunction set forth in substance that the Memphis & Charleston road has been so operated that the property of the petitioners therein has been depreciated.

Chesapeake & Ohio.—A receiver has been appointed for this company upon the petition of C. P. HUNTINGTON.

Rome and Decatur.—JOHN BYRNE, who was commissioned to make an examination of this road on behalf of the creditors of GROVESTEEN & PELL, reports that track is laid from Rome west 14 miles, and from Atlanta east 16 miles. A gap of 27 miles remains to be completed, and it is estimated that the cost of this, and equipping the road and meeting outstanding liabilities is $451,000. The creditors voted to complete the road and appointed as a committee to take charge of the work, R. L. EDWARDS, President of the Bank of the State of New York, EUGENE KELLY, J. W. OGDEN and JAMES SWAN.

Louisville, Cincinnati & Virginia.—About a mile of grading has been completed on this Kentucky road, and a considerable force is at work. The engineering force is at work between Beattyville and the Virginia line.

Versailles & Midway.— This company proposes to build the Lawrenceburg and Lexington extension which the Louisville Southern has surveyed. The work is conditioned on the securing of $200,000 in county subscriptions.

Ohio River.—Some preliminary surveys have been made for a branch line from New Martinsville, W. Va., through Wetzel, Tyler, Harrison and Doddridge counties.

Carolina, Knoxville & Western.—This road is to extend from Augusta, Ga., to Knoxville, Tenn., 265 miles. The line has been partially constructed from Augusta to Greenville, S. C., about 100 miles, has been located from Knoxville to the North Carolina State line and is now under survey from that point to Greenville. The city of Knoxville, N. C., has just voted $100,000 aid to the company. W. L. MAULDIN of Greenville, S. C., is President.

Columbia, Newberry & Laurens.—This South Carolina road is to run from Columbia to Spartanburg, about 100 miles, 12 miles of which are graded. H. C. MOSELEY, Prosperity, S. C., is President and CHAS. ELLIS, JR. is Chief Engineer.

New Projects and Surveys.—*Murfreesboro.*—This projected line is to be 7 miles in length, from the line of the Roanoke & Tar River R. R., to Murfreesboro, N. C., at the head of navigation on the Meherrin river. The Seaboard & Roanoke R. R. Co., will own a half interest in the road and furnish one half the money to build and equip it. The Township of Murfreesboro has subscribed $25,000 and will own the other half. An effort will be made to begin the grading this winter. B. B. WINBORNE of Murfreesboro is President.

Palatka, Lake Harris & Gulf.—This company has been chartered in Florida by J. A. LARNED of Palatka to build a railroad from Palatka to Palmetto.

Montgomery, Hayneville & Camden.—The surveys for this road are in progress under C. P. ROGERS, of Leetohatchie.

Danville & Seaboard.—The incorporators of this road held a meeting at Danville, Va., on Nov. 1, and elected W. T. SUTHERLIN, President.

Selma & Cahaba Valley.—The survey of this Alabama road from Selma to Bessemer is in progress.

Atlanta & Alabama.—The building of this proposed line from Atlanta to Selma is again being agitated. L. E. O'KEEFE, of Atlanta, is interested.

The Northwest.

Existing Roads.—*Red River Valley.*—The contract with MANN & HOLT, for the completion of the Red River Valley road, has fallen through. The Winnipeg citizens who were to subscribe $300,000 to the stock of the construction company, became suspicious that NORQUAY and HOLT were in collusion with the Canadian Pacific, and would accept nothing but an iron-clad agreement to construct the line in the face of any opposition that might be made. So much disagreement and bickering among the promoters of the enterprise is the most fatal obstacle which it has yet encountered.

Illinois Central.—On the Chicago, Madison & Northern line the bridge over Fox river is completed; there are six spans of 90 ft. each. It is a Warren truss, deck bridge, with riveted connections. The bridge across Rock river, at Rockford, Ill., is also finished. There are six spans of 140 ft. each. It is a through Pratt truss, with pin connections. All grading will be finished by Jan. 1, 1888. Track laying is in progress from Rockford eastward towards Chicago, and westward towards Freeport, Ill. RYAN & MCDONALD have the contract.

St. Paul, Minneapolis & Manitoba.—On the Willmar & Sioux Falls extension, the grading is about completed from Willmar to Marshall, Minn., about 70 miles. It is expected to complete the grading of the entire line from Willmar to Sioux Falls, nearly 150 miles, this season, with the exception of about 12 miles north of the crossing of the Dakota Central Railroad. C. F. B. HASKELL is Engineer in Charge.

The party which has been out since June, under JAS. CARSS working on the location of the Duluth, Pierre & Black Hills Railroad, have just returned from the field. They have completed the location from Aberdeen to Pierre, Dak., a distance of 128¼ miles. The maximum grade is 0.6 per cent., and the maximum curve is 3°. Grading is expected to commence early next season, the entire line to be in operation by October, 1888.

Aberdeen, Bismarck & Northwestern.—The managers of this company deny all the recent rumors that the line is to be sold to the Minneapolis & Pacific.

Minneapolis, Sault Ste. Marie & Atlantic.—Reports state that a five inch snowfall has occurred on the north Michigan peninsula. The grading and bridging are practically completed and five tracklaying gangs are at work. —It is reported that the company will purchase the Taylor's Falls & Lake Superior railroad, 20¾ miles in, length, from the St. Paul & Duluth company, and will build a bridge across the St. Croix river at Taylor's Falls to connect this road with their own line.

Fremont, Elkhorn & Missouri Valley.—Track layers on the Black Hills line are working between Sturgis and Whitewood Creek. Stages are now running from Sturgis to Deadwood, a distance of 14 miles. The Black Hills center is thus easy of access in comparison with the flush times of 1881, when it was only reached by a 250 mile stage journey from Bismarck.

New Projects and Surveys.—*Great Northwest Central.*—This company is the third to undertake the project of constructing a railway from some point on the Canadian Pacific near Brandon, about 150 miles west to Winnipeg, Man., to some point, more or less remote, in the Northwest. The Souris & Rocky Mountain was chartered in 1880, and graded, after a certain fashion, 42 miles across the prairies, which the Government Engineer refused to accept and the company collapsed. The Northwest Central was next organized, with JAMES BEATY, of Toronto, at its head, and received a liberal land grant and subsidy from the Dominion Government. The company has never been able to enlist the necessary capital, however, and no work has been done. The newest company, named above, has organized in 1886, by Senator CLEMOW, C. P. BATE, W. A. ALLAN, of Ottawa, and others, with a land grant and subsidy similar to that of the BEATY company. It is stated, however, that they have not been able to interest any outside capital and have not organized, to avoid making themselves personally liable. Their charter provides for a line from Brandon to Edmonton, a cool thousand miles. Some show of work is being made near Brandon, but it is confidently predicted that the usual disaster will overtake the enterprise before a very large amount of dirt has been moved.

Dubuque & Northwestern and Dubuque & Southwestern. —These two companies have been incorporated in Illinois by HENRY A. STEVENS, of Springfield, and others. The proposed line extends along the Mississippi river from Savannah to the Wisconsin State line.

Grand Marais & Vermilion.—R. W. PETRE, of Duluth, is interested in this projected line from Grand Marais to connect with the Port Arthur, Duluth & Western. He states that surveys are to go forward at once.

The Southwest.

Existing Roads.—*Missouri Pacific.*—The Denver, Memphis & Atlantic division, which is being extended to Pueblo, Col., is now operated by the company to Horace, Kan., 473 miles west of Kansas City. The track is laid from this point west to Galatea, 67 miles, and 54 miles beyond the Colorado State line, but the contractors have not yet turned over this part of the line to the company.—Surveyors are reported at work locating a line to Trinidad, Col., from a point on the Pueblo extension, near the State line.—Track laying is to begin this month on the Kansas & Arkansas Valley lines in Arkansas and Indian Territory.—On the Lexington & Jefferson City extension in Missouri the tracklaying gang is at work between Dover and Waverly, and about 15 miles are laid.

Denison, Bonham & New Orleans.—This Texas line is nearly ready for the rails between Denison & Bonham, a distance of 28 miles.

Atchison, Topeka & Santa Fé.—Ground has been broken for the extension from Fort Scott, Kan., eastward into Missouri, and grading will probably continue through the winter, if the season permits.—On the Chicago extension, track is being laid on about 150 out of the 350 miles, from Kansas City to Streator, Ill.

Chicago, Rock Island & Pacific.—Grading is to be pushed on the Denver line through the winter.

New Projects and Surveys.—*Springfield & Northern.* —A corps of surveyors are running a line from Springfield, Mo., north via Buffalo. It is surmised that they are in the interest of the Chicago & Alton, which company has for a long time contemplated an extension to Springfield, from its present terminus at Jefferson City.

Paragould & Buffalo Island.—The 8 mile line recently chartered by this Arkansas company is to be finished by Jan. 1, 1888. It is proposed to extend the line 16 miles to Cotton Plant, Mo. A. BERTIG, Paragould, Ark., is interested.

Kansas City & Sabine Pass.—The Kansas City *Times* discourses as follows on the benefits which are to accrue to that town from the above enterprise: "The Kansas City & Sabine Pass line, the contracts of which are to be let before very long, proposes to make Kansas City the headquarters of the system. Before the close of 1888 this company will own a line of road from Kansas City to Sabine Pass, on the Gulf of Mexico, and many miles of branch lines as feeders. Such a system will require immense shops for the manufacture of cars, engines, machinery and everything necessary to a railroad. Such shops will require the labor of from 300 to 500 men. Here will also be located the general offices of the company which will require the services of 100 clerks and officers. The freight department will require the services of another 100 bringing the total up to between 500 and 700."

It seems as if there were a faint similarity in the above to something we have read before. The reporter that wrote the above was probably not guilty of plagiarism, however. It was simply an instance of, "Nothing new under the Sun," and we commend to his perusal a romance written some time ago by a gentlemen named Æsop entitled "The Country Maid and the Milk Pail."

Interstate & Denver.—This Kansas company has been incorporated by WM. MARTINDALE of Madison and others. The proposed line extends from Madison to Denver, 400 miles.

Rocky Mountain and Pacific.

Existing Roads.—*Denver & Rio Grande.*—The tracklayers have reached Aspen, Col., and the line has been opened for passenger traffic. The last 45 miles of the extension were laid in 14 days.—It is reported that the officers of the company have planned considerable extensions in New Mexico for next season's work, to be undertaken if the financial outlook is favorable.

Denver, Texas & Ft. Worth.—The citizens of Trinidad, Col., have raised $120,000 subsidy to secure the location of the company's shops at that point. Work is to begin at once on the buildings, which will be extensive enough to accommodate four or five hundred hands.

Oregon Pacific.—Track laying is completed from Albany, Ore., east 58 miles and a portion of this is open for traffic. Grading is to continue through the winter.

Union Pacific.—It is announced that next season the Cheyenne & Northern, which now terminates 30 miles southeast of Douglas, Wyo., will be extended next season 150 miles, to Buffalo in the northern part of the Territory.

Chicago, Burlington & Quincy.—About 200 miles of lines are planned for next season's work in Wyoming, according to report.

Southern Pacific.—It is stated that the route for the extension from Templeton to San Luis Obispo, Cal., has been decided upon. The line is to pass the range by an 800 ft. tunnel.

Maricopa & Phoenix.—It is reported that this Arizona road is to be extended to Globe, a distance of 75 miles.

New Projects and Surveys.—*Loomis & Georgetown.* A narrow gauge railroad 35 miles in length has been surveyed between these California towns. W. GRAHAM is the Chief Engineer.

Westinghouse vs. Carpenter.—The U.S. Circuit Court in session at Des Moines, Ia., according to the St. Louis *Globe-Democrat*, holds that Westinghouse is entitled to preliminary injunction in the present battle between the above companies as to the ownership of the automatic coupling which is an essential feature of the air brake. The Westinghouse Co. had sued for an infringement.

Depots at Intersections of Railways.—A very important decision was handed down, on Oct. 24, by Judge BREWER, in the United States Circuit Court, in the case of Barton county against the Ft. Scott Railroad Co. The suit was brought for the negligence of the company in complying with the statute requiring a railroad to build a depot at its intersection with another railroad. The statute imposes a fine of $25 a day for the failure of any railroad to comply with these conditions. The railway company contended that the statute was unconstitutional. Judge BREWER, in his decision, stated that the statute was constitutional, and found for the plaintiffs. The amount claimed by the county, and granted by the judge, is $30,000.